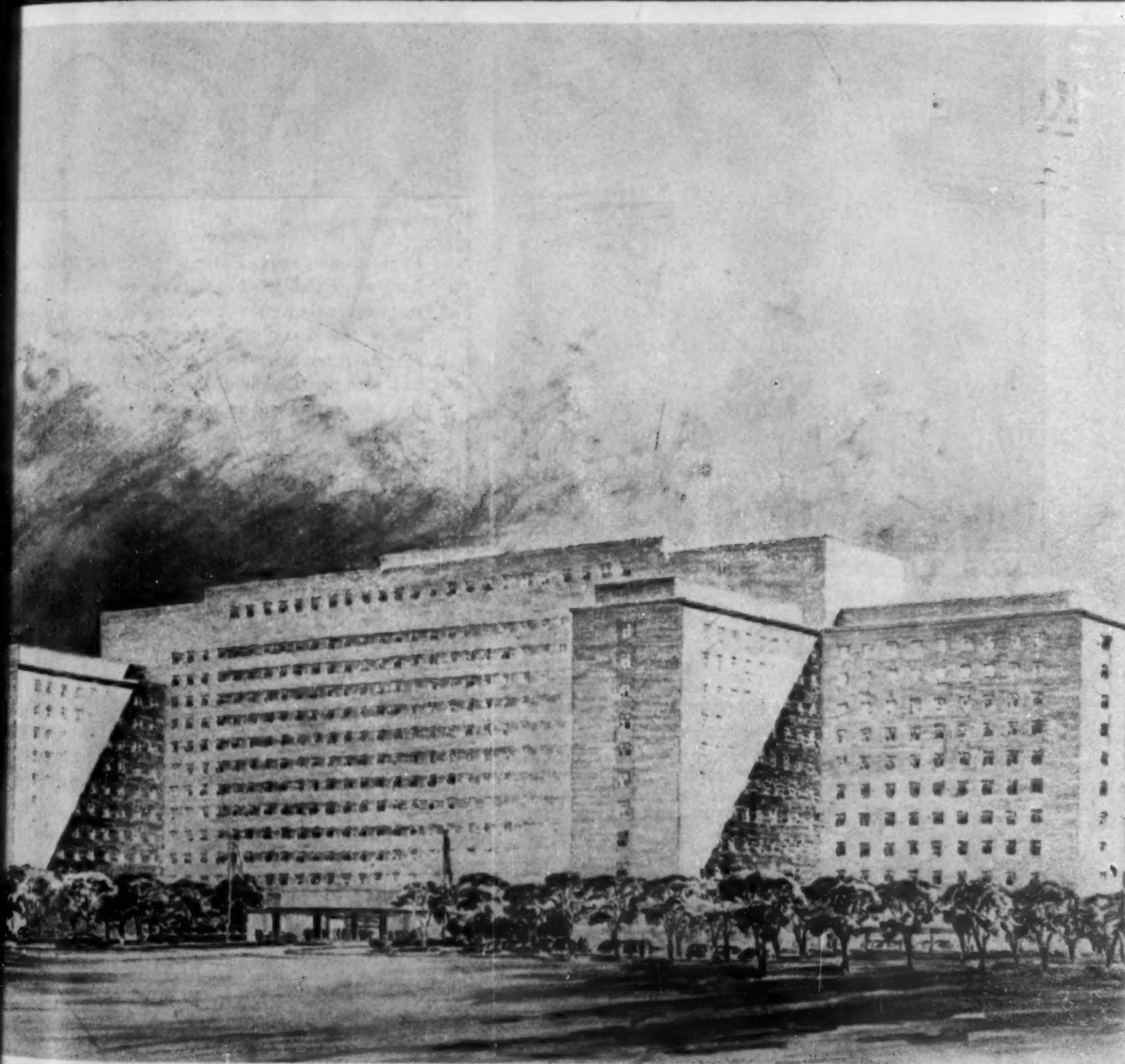


VOL. 108 • NO. 2808 • PAGES 423-431

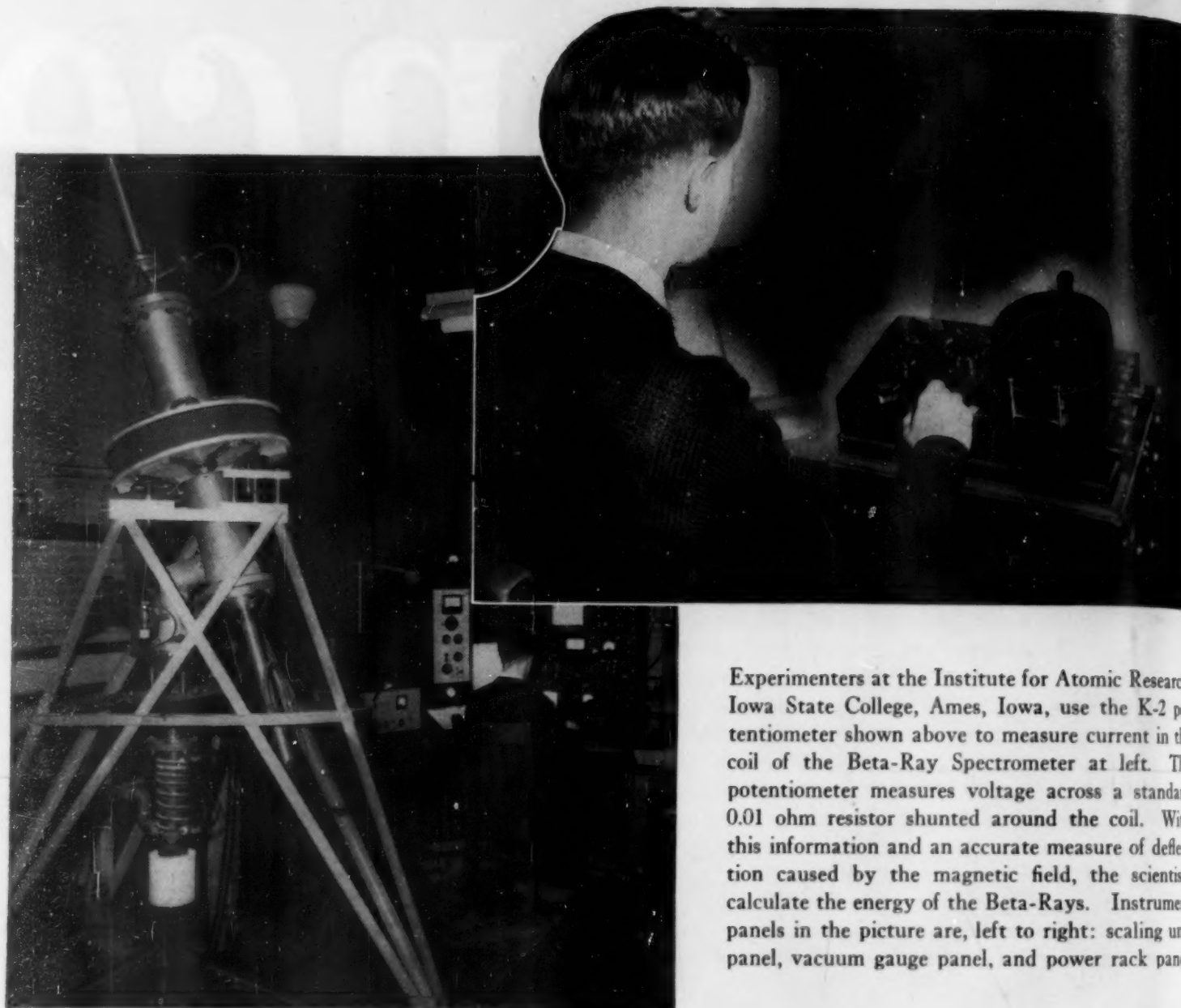
October 22, 1948

Science



Clinical Center, National Institutes of Health

(See page 423)



Experimenters at the Institute for Atomic Research, Iowa State College, Ames, Iowa, use the K-2 potentiometer shown above to measure current in the coil of the Beta-Ray Spectrometer at left. The potentiometer measures voltage across a standard 0.01 ohm resistor shunted around the coil. With this information and an accurate measure of deflection caused by the magnetic field, the scientists calculate the energy of the Beta-Rays. Instrument panels in the picture are, left to right: scaling unit panel, vacuum gauge panel, and power rack panel.

Measure Current Precisely with K-2 Potentiometers

For studying the tiny, speeding particles that constitute Beta-Ray, scientists require instruments that combine precision with great facility of operation.

These characteristics have won Type K-2 Potentiometers wide acceptance in laboratories throughout the country. K-2 is convenient to use because about 6% of each range is spread over the instrument's 5-meter slidewire, making it a simple matter to follow a small, fluctuating voltage with ease and accuracy.

Type K-2 has three ranges: 0 to 0.0161 volt, 0 to 0.161 volt, and 0 to 1.61 volts. It can be quickly standardized on any range. Even when used on a different range without restandardizing, only a slight degree of precision is lost for the sake of the convenience gained in those rare cases where such manipulation is necessary.

Further details in Catalog EH22(1), sent on request. Write to Leeds & Northrup Co., 4926 Stenton Avenue, Philadelphia 44, Pa.



MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

another
Aloe
exclusive

new
heavy duty
Van Slyke
manometric
apparatus



Modern, All-Metal, Fully Enclosed, More Convenient

This streamlined manometric apparatus contains new features for more accurate analysis and is equipped with Van Slyke-Folch extraction chamber for use in carbon determinations as well as gas analysis.

The entire shaking mechanism is enclosed in an all-metal, seamless housing. Motor, wiring, and driving gears are protected against spillage and fumes. The perfectly balanced housing and weighted base insure quiet operation. Crevices are minimized to prevent trapping of mercury.

Speed of ball-bearing motor, controlled by an improved rheostat, permits exact adjust-

ment at any desired point. Additional refinements for the operator's convenience include a trough for recovering mercury . . . individual fluorescent lights for reading manometer and extraction chamber . . . a rack-type slide holder for raising and lowering leveling tube . . . clearly etched graduations . . . gas tight stopcocks, selected for taper and bore, which reduce wear . . . entire apparatus can be carried by one man.

JL13590 Improved Van Slyke Manometric Apparatus, as described with manometer tube, extraction chamber, leveling bulb, aspirator bottle, thermometer, cord and plug but without mercury. For operation on 115 volts, A. C. each. . . . \$285.00



COMPANY

Serving Science Since 1860

1831 Olive Street • St. Louis 3, Missouri

Science

AAAS Editorial Board
(Terms expire July 31, 1949)
Arthur Bevan Bentley Glass Malcolm Soule
Edward Condon Everett Wallis
George Baitzell, *Editor-in-Chief*
Mildred Atwood, *Acting Editor of Science*
Advertising Representative, F. A. Moulton

Vol. 108 No. 2808 Friday, October 22, 1948

CONTENTS

Special Articles

New Light on the Peoples of Micronesia: *George Peter Murdock* 423

Food Prices in Palo Alto:
J. Murray Luck 425

Diversity of Amino Acids in Legumes According to the Soil Fertility:
V. L. Sheldon, et al. 426

AAAS Centenary—A Preliminary Report: *J. M. Hutzel* 428

Obituary

Arthur Gordon Ruggles: *William A. Riley* 430

News and Notes 431

Comments and Communications

Resignation of Professor Muller From Academy of Sciences of the USSR; On "Animal Hypnosis"; The Structure of Actidione, An Antibiotic From *Streptomyces griseus*; Present Distribution of Medical Research Funds by Governmental Agencies 436

Technical Papers

Ionic Exchange Equations Derived From Statistical Thermodynamics:
C. Krishnamoorthy, et al. 439

Cleavage Patterns Disclose "Toughness" of Metals: *C. A. Zapffe, et al.* 440

Deposition of Protein in the Liver Following Intravenous Injection of an Amino Acid Mixture (Hydrolyzed Protein) and Glucose:
Charles A. Ross and Robert Elman 441

Radical Reactions With Certain Nitrogen Compounds: The Conversion of Benzene (Toluene, etc.) in Other Compounds at Low Temperature: *Oskar Baudisch* 443

A Simple Ink Writer for the Mercury Manometer: *L. H. Anderson* 445

The Demonstration of P^{32} in Bone by Radioautography: *Robert S. Siffert* 445

Lipemic Nephrosis in Rats:
Walter Heymann and Herbert Z. Lund 448

Effect of Galactose on the Utilization of Fat:
Curt P. Richter 449

A Qualitative Chemical Change in Carcinogenesis:
Christopher Carruthers and V. Sontzeff 450

Book Reviews

An outline of social psychology:
Muzafer Sherif.
Reviewed by *Paul R. Farnsworth* 454

Science, a weekly journal, is published each Friday by the American Association for the Advancement of Science at The Business Press, Incorporated, N. Queen St. and McGovern Ave., Lancaster, Pa. Founded in 1880, it has been since 1900 the official publication of the AAAS. Editorial and Advertising Offices, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Telephone, EXecutive 0000 or 0001. Cable address, SCIMAG, Washington, D. C. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Sec. 538, P. L. and R., authorized January 15, 1948.

Articles offered for publication should be sent to the Editor. The AAAS assumes no responsibility for the opinions expressed by contributors. Membership correspondence for the AAAS should be sent to the Administrative Secretary.

Annual subscription, \$7.50; single copies, \$.25; foreign postage (outside the Pan-American Union), \$1.00 extra;

Canadian postage, \$.50 extra. Remittances and orders for subscription and single copies should be sent to the Circulation Department, AAAS, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, and 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Claims for missing numbers will not be allowed if received more than 60 days from date of issue. No claims allowed from subscribers in Central Europe, Asia, or the Pacific Islands other than Hawaii or because of failure to notify the Circulation Department of a change of address or because copy is missing from the files.

Change of address. Four weeks notice is required for change of address. This should be sent to *Science*, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. When ordering a change, please furnish an address stencil label from a recent issue. Address changes can be made only if the old as well as the new address is supplied.

The American Association for the Advancement of Science also publishes *The Scientific Monthly*. Subscription rates on request.

New Light on the Peoples of Micronesia

George Peter Murdock

Department of Anthropology, Yale University

MICRONESIA—a geographical and cultural area in the Pacific comparable to Polynesia, Melanesia, and Indonesia—comprises the Gilbert, Marshall, Caroline, and Marianas archipelagoes, which stretch east and west approximately 3,000 miles. Except for the Gilberts and the phosphate island of Nauru, which are British, the entire area is administered by the United States. Guam has been subject to American rule since 1898. The rest of the Marianas and all of the Carolines and Marshalls, which formerly constituted the Japanese Mandated Islands, have been administered under the United Nations since World War II as the Trust Territory of the Pacific.

The far-flung islands of the Trust Territory have a total land surface of less than 850 square miles, on which live about 70,000 native inhabitants. Prior to the last war, scientific knowledge of these people depended primarily upon a German expedition in 1908-10, supplemented by early explorers' accounts, scattered missionary reports, and a few leakages through the "copper curtain" imposed by Japan. The available information was as inadequate for military and administrative as for scientific purposes. This vacuum in knowledge has, within half a decade, yielded to an abundance of detailed information perhaps unparalleled for any comparable area in the world. How this has been accomplished is a story of cooperation between civilian anthropologists and the U. S. Navy, charged first with the conduct of war and then with administrative responsibilities in the area, which might well serve as a model for the collaboration of lay scientists and government agencies in a political democracy.

The first chapter in this story begins in 1943, when the Navy Department called upon a group of anthropologists associated with the Cross-Cultural Survey at Yale University to assemble and organize all available information on the area. With access to classified as well as to published sources, and with full clerical assistance and an adequate staff of Japanese translators, this group prepared a complete and organized file of all the information available, and between August 1943 and April 1944 issued 5 book-sized handbooks summarizing the material in a form readily usable by military government officers. These Civil Affairs Handbooks (OpNav 50E-1,4,5,6,7) are still the most

satisfactory and accessible sources of information about the islands prior to the American occupation.

The second chapter begins after the close of the war, when the Navy found it necessary to replace reserve officers trained in military government with regular officers in administrative positions in the islands. It turned to Felix M. Keesing, professor of anthropology at Stanford University, for assistance in organizing and conducting a School of Naval Administration at that institution. Through this admirably planned school have passed nearly all the officers who have subsequently been assigned to administrative posts in the Trust Territory. On the research side, the staff of the School has organized the information coming in from official reports and other sources and has incorporated it in revised editions of the Civil Affairs Handbooks, shortly to be issued.

The third chapter opens with the awareness by the Navy, in 1946, that existing information was insufficient for administrative purposes, particularly for the projected program of economic reconstruction. The U. S. Commercial Company, an RFC subsidiary, was asked to conduct an Economic Survey of the area. This was done under the direction of Douglas L. Oliver, an anthropologist, with a field staff which included a number of anthropologists—Leonard Mason, of the University of Hawaii, in the Marshalls; William Bascom, of Northwestern University, in Ponape; Edward Hall, of the University of Denver, in Truk; and John Useem, of the University of Wisconsin, in Palau and Yap. The Survey staff spent two months in the field and produced a number of voluminous reports which, though largely unpublished, added appreciably to scientific knowledge and proved of great value to administrators.

The fourth chapter—the last one thus far written—reflects the ultimate recognition by responsible naval officers, notably Adm. Chester W. Nimitz, Rear Adm. Carleton H. Wright, and Capt. William F. Jennings, that a fully satisfactory administration of the Trust Territory can be achieved only with complete knowledge of the peoples of the area. The National Research Council was asked to set up, through its Pacific Science Board, a Coordinated Investigation of Micronesian Anthropology (CIMA) and to invite the participation of American anthropologists in a large-scale program of field research. The Office of Naval

Research made a generous contractual appropriation, supplemented by a grant from the Viking Fund, Inc., and by contributions from various participating institutions, and, in addition, the Navy provided transportation to and from the islands, abundant supplies from war surpluses, and maximum local facilities and assistance.

With this support, the Pacific Science Board has been able to send into the Trust Territory during 1947 and 1948 more than 40 competent physical and cultural anthropologists, linguists, and geographers from 22 major institutions.¹ These scientists have worked intensively, for periods of from 3 to 12 months each, on 14 different islands: Guam, Ifalik, Kapingamarangi, Kusaie, Majuro, Mokil, Nomoi, Palau, Ponape, Saipan, Tinian, Truk, Ulithi, and Yap. The expedition is certainly the largest, and probably the best equipped, in the history of anthropology. It will shortly result in the most complete, comprehensive, and up-to-date scientific coverage of the people of any cultural or geographical area of the world.

In accordance with the policy of the Office of Naval Research, the results will be written up as contributions to pure science, which will become the basis for future administrative programs. Specific recommendations for local governmental changes have been invited in interim reports from the field, but final reports are to be neither censored nor oriented toward administrative objectives. The attitude and support of the naval personnel in Washington, Pearl Harbor, and Guam, and for the most part also in the field, have been scientifically unexceptionable as well as wholehearted and cordial.

The receptiveness of naval administrators to recommendations of the scientists for practical administrative changes has exceeded all expectations, as may be illustrated by a few of the experiences of the author and his associates on Truk. Restrictions on the importation of clothing, imposed on the assumption that the demand reflected missionary pressure to adopt European garb, were removed when it was pointed out that the natives require upper garments to prevent sunburn and to satisfy their own traditional concepts of decency. Superior chiefs were divested of their authority over marriage and divorce when it was shown that they were abusing it, and control was returned to the clans concerned as of old. The inhabitants of two native villages, who had been moved from their

homes near the naval base, were allowed to return when the resulting complications under the aboriginal system of land tenure were pointed out, thus removing a major source of irritation. The native political hierarchy, which has been complicated by increasing the number of levels from 3 to 6, creating difficulties in official communication and increased opportunities for petty tyranny and corruption, is currently being simplified to accord better with needs and primitive custom. To institute further reforms and adjustments, one of the anthropologists, Thomas F. Gladwin, was retained for an additional year as adviser to the island administration. (Similar posts have subsequently been created in Palau and the Marshalls.)

In consequence of this record of cooperation between the Navy and civilian anthropologists, Americans may feel reassured that their obligations to the United Nations are being satisfactorily carried out at the local level in the Trust Territory. The principal danger is that comparable relations with social scientists may not be maintained in Washington by Congress and its advisers in the preparation of legislation for the future government of the islands.

Despite good will and intelligence on higher and lower echelons, maladministration is likely to result if legislation ignores certain fundamental facts about the area. The most important of these are enumerated below in the hope that they may receive wider recognition.

(1) The Guamanians and the Chamorros of the other Marianas Islands form an indivisible cultural unit. That our administrative authority over them derives from different sources does not justify imposing serious restrictions upon communications, travel, and migration between them.

(2) The inhabitants of the Marianas have had intimate contact with European civilization for some 300 years, and have attained a level of culture comparable to that of the Filipinos. They are therefore ready for a maximum measure of self-government.

(3) The inhabitants of the Caroline and Marshall Islands are still primitive peoples in all essential respects. They are far, indeed, from being ready to accept our own complex legal and political institutions and make them work satisfactorily. Their traditional governments still operate reasonably well and can be transformed into democracies in the modern sense only through a long evolutionary process.

(4) The Caroline and Marshall Islanders are by no means homogeneous, but fall into a number of diverse cultural and linguistic groups with very different needs and attitudes. The Palauans are progressive and eager to adopt Western ways. The Yapese are ultra-conservative and deeply suspicious of foreigners. The Trukese desire material advantages but are satisfied

¹ These included the American Museum of Natural History, the Bernice P. Bishop Museum, the Chicago Natural History Museum, the Milwaukee Public Museum, the Institute of Ethnic Affairs, and the following universities: California, Chicago, Clark, Columbia, Connecticut, Harvard, Hawaii, Indiana, Michigan, Northwestern, Oregon, Pennsylvania, Southern California, Stanford, Sydney, Wisconsin, and Yale.

to return to their traditional social structure. * The Pona-ians, the Kusaians, the Marshallese, and the Polynesian inhabitants of Kapingamarangi and Nukuoro reveal equally distinct and divergent attitudes and cultural values. An attempt to administer these varied

groups according to a single inflexible formula would invite disaster. Legislation respecting them should be confined to establishing a neutral and humane overall policy, allowing great latitude to local administrators in adapting it to variable needs and conditions.

Food Prices in Palo Alto

J. Murray Luck
Stanford University, California

IN 1944 A REPORT ON FOOD PRICES in Palo Alto, California, was published in *Science* (August 11, pp. 124-125). These surveys, annual in character and initiated in 1939, have continued to be made. Since it is possible that the results of the survey may be of more than local interest, the later data are now presented for publication.

It might first of all be pointed out that Palo Alto is a small university town, now having a population of about 22,000. The town is a typical university community except for those engaged in business in San Francisco, some who are retired, and quite a small proportion of the whole who are employed by industries in Palo Alto and adjacent communities. Most of the residents, it may be concluded, are engaged in activities that center about Stanford University.

The survey of food prices referred to here has been made among the retail stores in Palo Alto, in all cases during the third or fourth week of May. Year by year the same items were priced. To give a proper weighting to the list, the quantities of various foodstuffs required for a "liberal" diet were used. The cost of such a diet was determined for one week's maintenance of an adult man engaged in moderate physical activity. It is recognized, of course, that many different "liberal" diets could be devised, though all would be characterized, according to present concepts, by being comparatively low in potatoes and highly processed cereals and comparatively rich in so-called high-quality protein foods. The particular diet that we have priced contains an abundance of dairy products, fresh fruits and vegetables, and high-quality proteins. It is not, however, a "luxury" diet. Differences in regional dietary practices or in availability of foodstuffs would permit many variations without serious trespass upon the limiting characteristics of a liberal diet. The particular foods about which these surveys have centered would provide, per day, approximately 3,100 Cal, 137 gm of fat, 318 gm of carbohydrate, 107 gm of protein, 1.36 gm of calcium,

2.04 gm of phosphorus, 20 mg of iron, 15,000 units of vitamin A or its equivalent, 160 mg of ascorbic acid, 370 units of vitamin D, 1.4 mg of thiamin, and 2.7 mg of riboflavin. These values refer to the food as purchased and should be reduced by probably 10% to reflect the values for food as consumed. The list of foods, per adult per week, is as follows:

Bread	1 lb	Sweet potatoes ...	1 lb
Oatmeal	$\frac{1}{2}$ "	Potatoes	3 "
Cornmeal	$\frac{1}{2}$ "	Cabbage	2 "
Sugar	1.2 "	Lettuce	$\frac{1}{2}$ "
Milk	3 $\frac{1}{2}$ qts	Carrots	1 "
Cheese	$\frac{1}{2}$ lb	Beets	1 "
Butter	$\frac{1}{2}$ "	Canned corn	$\frac{1}{2}$ "
Eggs (large, grade A)	1 "	Oranges	2 "
Lard	$\frac{1}{2}$ "	Apples	1 "
Bacon	$\frac{1}{2}$ "	Bananas	1 "
Beef chuck roast	2 $\frac{1}{2}$ "	Dried prunes	$\frac{1}{2}$ "
Salmon	1 "	Canned peaches ...	$\frac{1}{2}$ "

Five stores were included in the 1939 survey, 6 in 1940, 7 in 1941, and 9 in 1942 and subsequent years. Three of the stores in the 1939 list and four in the subsequent lists are members of chains. A large co-operative store was included. All small stores were deliberately omitted as well as one or two stores which cater to luxury trade and are recognized as atypical with respect to distribution costs and retail prices.

In the case of canned goods, the cheapest brands were priced. It is believed that the nutritive qualities were reasonably comparable. To obtain maximum economies in purchasing, quantity prices (up to 10 lbs) were used whenever feasible as the basis for the calculations (see Table 1).

The increases reported since 1939 are not to be considered as indicative of the extent to which the cost of living has increased. This is because cost-of-living indices include many items other than food and also because "liberal" diets are low in cereal products (which have increased the least) and rich in fresh

vegetables, fruits, fish, eggs, dairy products, and meat (which has increased the most). For example, while bread, oatmeal, and milk have approximately doubled in price since 1939, the present prices of beef and

TABLE 1

Year	Average cost at retail price	Percentage increase over 1939
1939	\$2.28	
1940	2.28	0
1941	2.96	30
1942	3.59	57
1943	4.72	107
1944	4.26	87
1945	4.26	87
1946	4.40	93
1947	5.96	161
1948	6.81	199

tinned salmon are about $4\frac{1}{2}$ times those of 1939. Cheese, butter, eggs, and fresh vegetables are about 3 times as costly as in 1939. Table 1 gives the cost of the diet as listed.

Prices used for carrots and beets are those for trimmed vegetables and represent strictly the cost of the edible portion. It is unfortunate that in most cases retail stores continue to sell these by the bundle rather than by net weight.

Since fortified margarine is now to be regarded as an acceptable substitute for butter and tinned mackerel is considerably cheaper than tinned salmon, even though somewhat lower in vitamin A, we have decided in the future to substitute these two items for butter and tinned salmon, respectively, in these dietary surveys. The hamburger now available locally, appears to be of higher quality than that sold in 1939, although in composition it is not yet satisfactorily defined. Nonetheless, it is widely consumed. If the list of foods published above were to be amended by the replacement of butter, salmon, and chuck roast of beef with margarine, tinned mackerel, and hamburger respectively, the cost of the liberal diet would fall from \$6.81 to \$5.53 for 1948.

The assistance of Barbara Davey in collection and compilation of the data is gratefully acknowledged.

Diversity of Amino Acids in Legumes According to the Soil Fertility

V. L. Sheldon, Wm. G. Blue, and Wm. A. Albrecht
University of Missouri, Columbia, Missouri

AGRICULTURE IS CONCERNED WITH the synthesis of food. Our ultimate goal in this industry has always been the increase of production, *i.e.* greater numbers and more pounds, per acre. Too often only such physical attributes of the products—even of people—are of prime consideration when some other criteria are of more fundamental importance. We neglect the quality of our food products and continue to measure our output only in bushels and tons per acre.

In accordance with the long-held belief that a specific crop is of value because it produces much bulk, we have imported many exotic plants in the hope of maintaining a high level of food production. While watching the delivery of bulk, we have kept up the synthesis of caloric compounds by plants, but much of their capacity to synthesize proteins has been lost. For these latter, or body-building, substances, more than good weather is necessary; plants, like animals, can be said to be, and to behave, only according as they are nourished via the soil.

When the soil fertility declines, our attempts to adapt crops to this lower level of plant nutrition become a fallacy in terms of the demands of the animal diet. Of the many requirements of any diet, protein presents itself for first consideration. In the production of healthy animals the major problem is this one of obtaining sufficient protein of the quality commensurate with nutritional demands. Just as the furnace must be constructed prior to its service in consuming fuel, so must the animal use proteins to build its body prior to any consideration of its expenditure of energy. In the animal the mere hanging on of fat is much of a luxury performance to which we have all wantonly subscribed. In agriculture we must become concerned with the biosynthesis of the building stones of the body, namely, the amino acids, making up the proteins and not be content to adopt as our criterion the photosynthesis of the carbohydrates composing the plant bulk.

While this plant bulk may reflect other factors of the environment, we have been able to trace many of

for nutritional problems to the effects of the ash constituents coming via the plant. These soil-borne nutrients control plant metabolism more than we yet appreciate. Biosynthesis requires these inorganic elements, not only to catalyze various reactions within the plant, but also to fashion and to build its structure. In turn, animals depend on the plants to synthesize the protein constituents for them. Herein lies the vital function of the soil. According as the different soils deliver divergent quantities of the inorganic elements, so we experience the pattern in the biological array of the plant species. Each species presents a different organic composition according to the differences in the soil fertility.

In order to determine what fertility elements might be the cause of these diversities, alfalfa was grown on a single soil given treatments of the separate trace elements, manganese and boron, and a mixture of these with some others, as supplements to the common fertilizer elements calcium, phosphorus, and potassium. Wide diversity in the amino acid array in the protein could scarcely be expected when relatively small amounts of these trace elements are applied on the surface of the soil. Yet the quality of the alfalfa protein in terms of its constituent amino acids was modified by these soil treatments, as shown in Table 2. While a marked diversity manifested itself in the case of each amino acid, the methionine content varied

TABLE 1
AMINO ACID CONTENT OF LESPEDEZA HAY ACCORDING TO DIFFERENT SOIL TYPES AND TREATMENTS
(Per Cent Dry Weight)

Soil type and treatment	Valine	Leucine	Arginine	Histidine	Threonine	Tryptophane	Lysine	Isoleucine	Methionine
Idon—treated .....	.895	1.055	.646	.375	.632	.294	.992	2.08	.092
untreated .....	.917	.978	.429	.343	.569	.205	.943	1.67	.086
Antonia—treated .....	.922	1.038	.451	.342	.625	.279	.872	1.63	.077
untreated .....	.780	1.014	.329	.306	.544	.181	.878	1.68	.077
Vtnam—treated	1.023	1.280	.716	.362	.639	.244	.894	1.89	.084
untreated .....	.986	1.289	.563	.503	.606	.227	1.007	2.26	.080
Grundy—treated	1.010	1.174	.627	.367	.690	.196	.797	2.00	.079
untreated	1.137	1.460	.456	.381	.671	.195	.938	2.00	.082
Arkville—treated .....	.853	1.025	.340	.389	.585	.258	.930	1.59	.076
untreated .....	.941	1.199	.367	.356	.557	.215	.870	1.38	.074

In some recent studies, lespedeza was grown on 5 rotating experiment fields with 5 different soil types representing the 5 major soil regions of Missouri. The protein quality of this crop in terms of the different amino acids was assayed by using the newer microbiological techniques. The diversity in the plants' contents of these constituents of the protein molecule manifests itself in going from one soil to another, as shown in Table 1. Here, in terms of the

most widely of all the amino acids measured in this study. Seemingly these results substantiate the hypothesis that these two trace elements, namely, manganese and boron, function in the conversion of the carbohydrate into protein.

The data in these two tables illustrate well the wide variations in concentrations of these amino acids because of (a) differences in the crops and (b) differences in the fertility of the soils. Since the need to

TABLE 2
AMINO ACID CONTENT OF ALFALFA HAY ACCORDING TO SOIL TREATMENTS WITH TRACE ELEMENTS
(Percentage of Dry Leaves)

Plot No.	Treatment	Valine	Leucine	Arginine	Histidine	Threonine	Tryptophane	Lysine	Isoleucine	Methionine
1	Calcium	2.19	4.37	0.380	0.654	0.862	0.546	1.57	2.64	0.100
2	Calcium and manganese ...	2.40	4.89	0.434	0.807	0.954	0.640	2.12	3.63	0.242
3	Calcium and boron	2.13	5.55	0.418	0.726	1.071	0.856	2.13	4.09	0.173
4	Calcium and mixture*	2.59	5.24	0.415	0.835	1.014	0.670	1.87	3.44	0.229

* Mixture of cobalt, copper, zinc, manganese, and boron.

quality of the protein produced through biosynthesis by the plant, we have a more significant yardstick by which to measure our agricultural production according to the different soils, to say nothing of the different products themselves.

grow protein is greater than that of growing carbohydrates, both for man and animals, here is the suggestion that we should use a more critical measure of our agricultural production—the quality of it according to the fertility of the soil.

A more critical examination of the final crop products is needed. We need to measure not only their physical attributes as bushels and tons but also the amount and quality of their protein, thereby giving fuller consideration to the fertility of the soils on which the products were grown. The diversity of the amino acids within these crops demonstrates clearly that the fertility level of the soil determines our agricultural production in terms of the protein output,

which is much more significant than its commonly considered control in terms of only bushels and tonnage. When the national food problem is now looming larger, we believe it is high time to adopt this new criterion by which to view and direct the creative business that is agriculture.

Encouragement of these studies by the support of Swinburn and Company is gratefully acknowledged.

AAAS Centenary—A Preliminary Report

J. M. Hutzel, *Assistant Administrative Secretary*

SEPTEMBER 20, 1948, MARKED THE COMPLETION of the first 100 years in the history of the AAAS and followed by a few days the week-long eventful celebration of the 100th anniversary meeting in Washington, D. C. It is estimated that more than 5,000 persons attended the various sessions and functions. Registration, required for attendance at the morning symposia, was officially tabulated at 2,000, more than half of this number having registered in advance. Unlike previous meetings of the Association, with 60 or more sections and societies organizing as many as 360 sessions, the Centennial Meeting was comprised of only 14 technical symposia and 19 evening lectures. Each symposium consisted of three papers, augmented by a panel of two or three discussants. These sessions ended with a question period during which the audience submitted written questions to the speakers. It was the consensus of the chairmen that audience participation was enthusiastic and contributed much to the high success of the meetings.

The afternoon tours were among the major attractions of the Centenary. In every case the number wishing to participate in the tours exceeded expectations, and with one exception approached the capacity of the cooperating institutions to handle visitors. Chartered buses carried 300 to the Agricultural Research Center at Beltsville, Maryland; more than 500 to the National Institutes of Health and the Naval Medical Center; 180 on the circulating tour to the Geophysical Laboratory and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and the National Bureau of Standards. An additional busload of sightseers spent an entire afternoon at the Bureau of Standards, and many more participated in the "open house" activities sponsored by this institution on Friday, September 17, the final

day of the meeting. The national defense tours to the David Taylor Model Basin, at Carderock, Maryland, and to the Naval Research Laboratory by way of the National War College, were participated in by 112 and 88 persons, respectively. That the tours were interesting and stimulating was generally acclaimed, and the administrative officers of the Association warmly acknowledge the generous cooperation of the participating laboratories in accommodating visiting scientists. All the host institutions welcomed the inspection of those assembled for the occasion of the Centenary, and many scientists who could not take the formal tours found time to make a leisurely survey of research activities related to their special interests.

An outstanding exhibition of the investigations carried on by the Division of Biology and Medicine of the Atomic Energy Commission was on public display in the Statler Hotel during the week of the Centenary. Special exhibits illustrated isotope distribution, the inducement of mutations by radiations, instrumentation, and methods of safeguarding the health of employees engaged in atomic research. By operating instrument controls, visitors were able to detect with Geiger counters radioactivity in inanimate and animate subjects, e.g. a bar of uranium and frogs in a tabletop pond. Automatic devices demonstrated the shielding effect of several materials against the different emanations of a variety of radioactive substances. This exhibition, prepared under the direction of Dr. James H. Jensen, chief of the Biological Branch of the Division of Biology and Medicine, proved to be one of the principal attractions of the meeting.

The opening session on Monday evening, September 13, in Constitution Hall was addressed by the President of the United States and Dr. Shapley, retiring president of the AAAS. It is customary for the president of the AAAS to deliver an address before

monly con-
d tonnage
w loom
this new
ne creati
rt of Sw
Secret
urs to
Marylan
ay of
in by
ours we
acclaim
ssociati
on of
g visit
ed the
on of
not tak
ly surv
interest
tions en
dicine
e displ
entenan
tion, th
rument
h of en
operati
teet wi
and an
ogs in
ated th
ne diff
substanc
a of D
branch
ed to
g.
ptembe
e Pres
retirin
for th
before

the general assembly of the meeting held the year following his retirement from office, and on this occasion Dr. Shapley spoke on "One World of Stars." His address was illustrated in part by moving pictures of eruptions from the surface of the sun. The reception held later that evening in the Pan American Union Building attracted several thousand members and registered guests. Those in the reception line included Dr. and Mrs. Shapley, Dr. Stakman, and Dr. and Mrs. Sinnott. Refreshments were served in the Hall of the Americas, and guests found pleasant relaxation in the beautiful open-air gardens behind the building. Music was provided by the U. S. Air Force Band, and floral decorations were arranged through the courtesy of the U. S. Botanic Garden.

The evening sessions were open to the general public and in nearly all cases attracted capacity attendance. Programs sponsored by the Association and the National Geographic Society and the Association and the Society of the Sigma Xi were particularly popular due in part to the high reputation these joint lectures have attained at previous AAAS meetings. "What Hope for Man," subject of debate for the well-known radio forum presented weekly by The Town Hall, Inc., was broadcast on Tuesday evening, September 14, as one of the special events of the meeting. A report from the corporation's New York office states that respondents to the program were divided almost equally into diametrically opposing camps. "One group has been stirred to express their enthusiastic praise in an abundance of superlatives. They all feel that this discussion surpassed all previous 'Town Meetings,' and some of them insist that it was the most vitally important program ever broadcast. One teacher was so impressed that he has decided to give a copy of the transcript to each of his students and then offer a \$50 prize for the best essay on the subject.

"Those who are critical of the program all have the identical complaint—that there were no representatives of religion to discuss a question which they feel can be answered only by religion.

"There was particular interest in the question asked regarding what children should be taught, and a number of listeners have given their answers to the query. Belief in God, how to search for truth, and practical psychology have been mentioned most often."

The growing interest of the radio industry in presenting programs of true educational merit is reflected in the steadily increasing coverage given the postwar meetings of the Association. Mr. Irving Gitlin, representative of the Columbia Broadcasting System, states that in his opinion network programs devoted to the AAAS Centenary by CBS "represent coverage of an organizational meeting second only to that de-

voted to political conventions." Quincy Howe, CBS news analyst, presented a daily feature throughout the week of the meeting entitled, "You and Science." Other CBS programs included "Adventures in Science," moderated by Watson Davis, director of Science Service; "The Peoples Platform"; and late evening news commentaries devoted exclusively to the meetings. In addition to broadcasts originating with the networks and with the local stations, a number of outstanding telecasts were aired by WTTG, Dumont television station; WNBW, NBC television station; and WMAL-TV, ABC television station. These included "Learning and Growth," with Arnold Gesell, Yale University; "Mapping the News," with Kirtley Mather, Harvard University; "Solar Prominences," with Leo Goldberg, University of Michigan; and "Event of the Week," with Harlow Shapley, Harvard University.

The proceedings of the Centenary were well distributed to the public under the able direction of the AAAS press director, Dr. Sidney S. Negus, of the Medical College of Virginia. According to Dr. Negus, approximately 180 newspaper and magazine representatives reported the meetings. One well-known science writer found that he "had difficulty in covering the Centenary thoroughly and doing justice to all the fine speakers." Small wonder that the usual type of AAAS meeting with its thousands of papers calls for very close cooperation between authors and representatives of the press in the proper interpretation of science to the public!

In general, the Centennial Meeting was a great success—a success prompted to some extent by the occasion itself. The following are typical excerpts from letters received in the Washington office, the first by a speaker and the second by a science writer:

I enjoyed the meetings very much, and I hope the AAAS will continue to make its meetings of this integrating and cross-disciplinary type. There is not much need for an organization which simply duplicates the work of the specialized societies. But there is great need for an organization for intellectual trading among specialists.

So far as I was concerned, it was the best AAAS meeting I've attended in 16 years, and I've not missed many.

Problems resulting from the growing size of the annual meetings of the Association and the high cost of operations have led to much debate, among its officers, as to the kind of meeting the AAAS can organize in the best interests of science. The search for a satisfactory solution is reflected by a resolution passed at the Centenary directing that the Council be polled as to the type of meeting the Association should plan following the New York meeting. The

alternatives to be voted upon are: (1) to continue as in the past with no change; (2) to adopt the conference type of meeting, without provision for specialized activities of the sections and affiliated societies; (3) to alternate the two types of meetings.

The New York meeting, to be held from December 26 to 31, 1949, will be conducted in the same manner as the last Chicago meeting. The affiliated and associated societies are cordially invited to meet with the Association. It may be necessary to prorate session rooms in such a way as to insure the housing of related societies in the same or closely adjacent hotels, since this meeting promises to be the largest in the history of the Association.

The achievement of a meeting notable for its harmonious progression of events and atmosphere of accomplishment and good will may be traced to a large extent to the efficient operations of the local committees. In September of 1947 the heads of 40 educational and cultural institutions in the Washington area named representatives to a Centennial Planning Committee, which in turn appointed a subcommittee charged with formulating host plans and policies for the Centenary. The members of this subcommittee included Dr. Waldo Schmidt, Smithsonian Institution; Dr. Lloyd Berkner, Carnegie Institution of Washington; Cdr. J. O. Baker, David Taylor Model Basin; and Col. W. R. Wolfinbarger, The National War College. These men, in cooperation with the administrative officers of the Association, outlined the establishment of local committees and their functions. The chairmen and subchairmen who accepted invitations to bear the principal responsibilities for carrying out the many time-consuming committee tasks were: Equipment, E. G. Stanley Baker,

Catholic University of America; Patrons, Daniel Hall, American Security & Trust Company; Publicity, Austin H. Clark, Smithsonian Institution, assisted by Watson Davis, radio chairman, and Gordon Hubble, television chairman; Reception, Alexander Wetmore, Smithsonian Institution; Afternoon Activities, Raymond L. Zwemer, National Academy of Sciences; Registration, Elmer L. Kayser, George Washington University; and Transportation, V. D. Long, National War College. Registration personnel was furnished through the courtesy of the Greater National Capital Committee.

To help defray the costs of the local committees, AAAS members residing in Washington and its suburbs were asked to volunteer their services during the meeting or to contribute a small sum toward expenses incurred by the host committees. Approximately 300 of the total 1,429 local members made contributions amounting to \$883, and 68 volunteered to help. Those who offered to render personal assistance helped staff the information booth at the Statler Hotel or aided members of the equipment committee in collecting the written questions from the audiences at the morning symposia. For a most noteworthy meeting on the occasion of its 100th anniversary, the Association is indeed grateful to those named who served on the various committees and to the many unnamed contributors and volunteers.

This preliminary report of the Centennial Celebration will be followed by a summarized proceedings of the Centenary in the November 26 issue of *Science*. Many of the anniversary papers will be published in *Science* and *The Scientific Monthly*, and present plans call for the publication of the symposia in special volumes during the forthcoming year.

Obituary

Arthur Gordon Ruggles

1875-1947

Arthur Gordon Ruggles, professor emeritus of entomology and economic zoology at the University of Minnesota, and for 25 years State entomologist, died December 23, 1947, in Professional Center hospital, Montgomery, Alabama, at the age of 72 years. Since his retirement, his home had been in Union Springs, Alabama.

He was born May 30, 1875, in Annapolis Royal, Nova Scotia. He was graduated from the Truro

(Nova Scotia) Normal School and from the Truro Agricultural School. After teaching for a time in the Provincial schools, he entered the College of Agriculture of Cornell University and was granted the B.S.A. degree in 1901. His graduate work in entomology was interrupted, but he returned to complete his work for the A.M. degree in 1904.

In 1902 he joined the staff of the University of Minnesota, where he remained for 41 years, first as assistant professor of entomology and assistant to the State entomologist (1902-13) and then as associate professor (1913-18), professor and, succeeding F. L.

Washburn, State entomologist (1918-43). During the year 1912-13 he served as entomologist of the Pennsylvania Chestnut Blight Commission. In 1940-41 he was chairman of a committee requested by the Bureau of Entomology and Plant Quarantine to evaluate the work on control of the gypsy moth.

Prof. Ruggles was an outstanding teacher who was ever ready to aid his students in their problems, whether scholastic or personal. Many of the leaders in agriculture throughout the state recall with deep appreciation their contacts with him during their student days.

Responsible for details of regulatory work, as he was almost from the beginning of his appointment at Minnesota, his approach was primarily that of an educator rather than as an officer of the law. Genuinely interested in the problems and frank and open in his approach, he won the cooperation of those with whom he had to deal. This was manifest in his enforcement of the State Nursery Inspection laws, in the development of the bee inspection work, and in the orchard clean-up campaign which he initiated in cooperation with the growers.

Prof. Ruggles was a member of the AAAS, the American Association of Economic Entomologists (president, 1923), and the Entomological Society of America (first vice-president, 1937) and was permanent president of the International Great Plains Entomological Conference from 1935 to 1946. He had a genuine love for growing plants and was an active member of the State Horticultural Society.

Although he published numerous papers in the *Journal of Economic Entomology* and in various agricultural and horticultural journals, his chief contributions were in the form of timely bulletins and circulars of the Minnesota Agricultural Experiment Station and in the Reports of the State Entomologist. As a colleague, Arthur Ruggles was always consulted on departmental matters, for his prime consideration was the best interest of the department rather than sectional. Through his friendly nature, his live interest in entomological problems, and his cooperative spirit he won a host of friends who mourn his departure.

WILLIAM A. RILEY

University of Minnesota

NEWS and Notes

Raymond A. Paynter, Jr., zoologist of the Peabody Museum of Natural History, Yale University, has left on a one-man scientific expedition to the Yucatan Peninsula, British Honduras, and Guatemala. Mr. Paynter's objective will be the collection of more than 1,000 bird and mammal specimens from little-known areas of Middle America during the next 6-8 months. In addition to his zoogeographic studies, Mr. Paynter plans to investigate the ancient Mayan Indian ruins and to record his findings in motion-picture film and photographs. The Yale Middle America Expedition is being financed by the Peabody Museum, the Society of the Sigma Xi, and by Mr. Paynter, who will use the collected materials of his trip for a Ph.D. dissertation on the zoogeography of the Yucatan Peninsula.

David D. Whitney, professor and chairman of the Zoology Department

at the University of Nebraska, has become professor emeritus of zoology. He will continue to live in Lincoln.

G. E. F. Lundell recently retired as chief of the Chemistry Division, National Bureau of Standards, a position he has held since 1937. Dr. Lundell will remain on the Bureau staff as consultant to the Division. Edward Wichers, former assistant chief, has been appointed Division chief, while William Blum, former head of the Electrodeposition Section, will become the new assistant chief.

Theodore L. Jahn, formerly associate professor of zoology at the State University of Iowa, has recently been appointed professor of zoology at the University of California, Los Angeles.

Perley Spaulding recently retired from the position of principal pathologist in charge of the field laboratory, Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA, at New Haven, Connecticut. Dr. Spaulding, who this year received a Distinguished Service Award from the USDA for his unusually productive research and outstanding contributions to the

science of forest pathology, will continue special lines of work for the Bureau as a collaborator. J. R. Hansbrough has succeeded Dr. Spaulding as head of the Division's laboratory at New Haven.

Albert Einstein, of the Institute for Advanced Study, Princeton, New Jersey, has been elected to serve on the Advisory Board of Roosevelt College, Chicago.

J. Roy Doty, a member of the staff of the American Dental Association since 1943, has just been made director of the Association's Bureau of Chemistry. In his new position Dr. Doty will be in charge of research in the Association's laboratories in Chicago, where various chemicals and drugs used by the dental profession are examined.

Frank D. Fackenthal, formerly provost and acting president of Columbia University, has been named educational consultant on college administrative problems during the coming year for the Carnegie Corporation of New York. According to Charles Dolard, president of the Corporation,

Dr. Fackenthal will visit campuses throughout the country and will also be available for consultation by appointment at the Corporation's New York headquarters, 522 Fifth Avenue.

Alfred Lewin Copley, of the Department of Biology, New York University, has been giving a series of lectures in Holland. These included "Rheological Problems in Biology," presented before the International Rheological Congress at Scheveningen; "Theories of Intravascular Blood Clotting," given at the University of Leiden; and "Mechanisms of Hemorrhage and Hemostasis," presented at the Genootschap ter Bervordering van Natuur-, Genees-, en Heelkunde in Amsterdam.

Elizabeth Roboz, formerly of the Sugar Research Foundation, Cornell University, has joined the Food Research Laboratories of the Stanford Research Institute.

Donald Flanders recently joined the staff of the Theoretical Nuclear Physics Division, Argonne National Laboratory, as a senior physicist. Dr. Flanders, formerly of the Theoretical Physics Division at the Los Alamos Scientific Laboratory, had been associated with New York University from 1929 through July 1948.

Roy L. Swank, formerly of the Department of Neurology, Harvard Medical School, was recently appointed assistant professor of experimental neurology in the Department of Neurology and Neurosurgery at McGill University. Dr. Swank will conduct a program of experimental and clinical research on multiple sclerosis and related problems at the Montreal Neurological Institute.

Grants and Awards

The Albert and Mary Lasker Foundation 1948 awards to a group of three scientists and four public health administrators were recently made public at a meeting of the New York Academy of Medicine by George Baehr, chairman of the committee of the American Public Health Association that selected the recipients. Formal presentation of the awards will be made during the meeting of the Amer-

ican Public Health Association in Boston on November 11.

Individual scientific awards, consisting of \$1,000 and a gold statue, will be made to Selman A. Waksman, of Rutgers University; Rene J. Dubos, of the Rockefeller Institute; and Vincent du Vigneaud, of Cornell University Medical College. Dr. Waksman and Dr. Dubos were jointly cited for their studies of the antibiotic properties of microorganisms in the soil. Dr. Vigneaud was cited for his contribution to the chemistry of vitamins and nutrition and for leading a research team that first produced a synthetic penicillin.

Awards for administrative achievement go to Martha M. Eliot, of the U. S. Children's Bureau, Washington, D. C., and to Rolla E. Dyer, of the National Institutes of Health. Dr. Eliot will be honored for organizing and operating medical centers for the families of servicemen during the war, while Dr. Dyer is cited for his work in allotting medical research funds. For its efficient program of medical care for veterans the Department of Medicine and Surgery of the Veterans Administration will receive the Group Award, consisting of a silver statuette, with particular honor to Paul R. Hawley, former medical director, and Paul B. Magnuson, present medical director.

The Chemical Industry Medal for 1948, conferred annually by the American Section of the Society of Chemical Industry for outstanding application of chemical research to industry, will be presented to James A. Rafferty, vice-president of Union Carbide and Carbon Chemicals Corporation, New York City, at a dinner meeting in the Waldorf Astoria Hotel, New York City, on November 5. Mr. Rafferty was cited particularly for his leadership in developing the billion-dollar synthetic aliphatic industry, strategic field of chemical production vital to the national economy. During World War II, Mr. Rafferty was executive officer in charge of the Union Carbide operations in connection with the Government's synthetic rubber and atomic energy projects.

Harold M. Chase, director of research and superintendent of dyeing at the Dan River Mills, Inc., of Dan-

ville, Virginia, was recently named winner of the 1948 Olney Award for outstanding achievement in the field of textile chemistry. Presentation of the medal to Mr. Chase will take place during the 27th national annual convention of the American Association of Textile Chemists and Colorists now being held in Augusta, Georgia.

The School of Mathematics, Institute for Advanced Study, will allocate a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and do research work at Princeton during the academic year 1949-50. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph.D. degree. Blanks for application may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, New Jersey, and are returnable by February 1, 1949.

The National Committee for Award for Grants-in-Aid from the Sigma Xi Research Fund has announced the following grants amounting to \$4,150:

\$200 to Roland H. Alden, University of Tennessee, for aid in studies of the histochemistry and growth of trophoblast cells and implantation of the embryo.

\$400 to Max E. Britton, Northwestern University, for a microbiological study of a Michigan peat bog.

\$250 to Victor H. Dropkin, Roosevelt College, for a study of genetics of *Neoplectana glaseri*.

\$400 to Taylor Hinton, Amherst College, for a study of dietary effects on gene manifestation in *Drosophila*.

\$250 to Charles A. Leone, Rutgers University, for a study of systematic serology of the Crustacea.

\$250 to Raymond A. Paynter, Jr., Yale University, to aid in studies of the birds of southern Yucatan, Mexico.

\$100 to Robert B. Platt, University of Pennsylvania, to aid in an ecological study of the shale barrens of the mid-Appalachian Mountains.

\$250 to Reinhold Rudenberg, Harvard University, to aid in an investigation of the focal properties of cathode-ray guns and illuminators.

150 to Frank R. Shaw, University of Massachusetts, for a study of phylogeny of the *Mycetophilidae*.

250 to C. S. Smith, Case Institute of Technology, for a study of the structure of cobalt at elevated temperatures.

300 to Wilhelm Solheim, University of Wyoming, to aid in the collection and study of parasitic Rocky Mountain fungi, with reference to antibiotics.

300 to Pierre Van Rysselberghe, University of Oregon, for a study of application of the cathode-ray collagraph to polarography.

300 to Floyd G. Werner, Harvard University, to aid in the collection and study of Anthicidae in Mexico.

250 to Philip L. Wright, Montana State University, to aid in histochemical analyses of weasel uteri.

500 to Albert C. Zettlemoyer, Lehigh University, for a study of adsorption of gases on organic surfaces.

Colleges and Universities

A cooperative expedition to excavate the ruins of Nippur (Iraq), a project begun 50 years ago by an expedition sent out by the University of Pennsylvania, will get under way this fall with excavation work concentrated at two sites—the temple of Enlil and the temple library. The work is being assumed by the Oriental Institute of the University of Chicago and the University of Pennsylvania Museum.

Donald E. McCown, associate professor of archeology at Chicago, who has just recently returned from an expedition to Iran, will be in charge and will be assisted by Francis Steele, University of Pennsylvania epigrapher, Joseph Caldwell, archeological architect of the Smithsonian Institution, and Mrs. McCown. The archeologists hope to recover from the library ruins literary and mythological texts which will reveal Sumerian thought. Excavation of other important temples and palaces will be undertaken in the future.

A lecture course on the Genetics of Microorganisms is being offered in the Department of Botany and Microbiology, Yale University, during the first term of the present academic

year. Course lectures are to be given by members of the staff and by a number of visiting biologists, including M. Demerec, R. Emerson, A. Frey-Wissling, A. D. Hershey, N. L. Horowitz, J. Lederberg, C. C. Lindegren, S. E. Luria, M. McCarty, W. J. Nickerson, J. Preer, K. Roberts, F. J. Ryan, J. Singleton, T. E. Sonneborn, A. Srb, E. C. Stakman, and L. J. Wickerham. The lectures, which will cover genetic problems in the fields of viruses, bacteria, protozoa, fungi, and algae, will be given on Tuesdays and Thursdays at 4:30 P.M. Anyone interested in this field may attend.

A modern seismograph, known as the Sprengnether seismometer, is being readied for use at the University of Washington within a few months, according to George E. Goodspeed, head of the Geology Department. The new apparatus, which will supplement a Japanese-designed unit which has recorded quakes since 1907, will permanently record earthquake locations and intensities on a continuous photographic film, including vertical vibrations as well as east-west and north-south vibrations. In addition to the photographic records, visible graph lines will be transmitted to an indicator in the geological offices. Eiyo E. Vesanen, prominent Finnish seismologist, who recently joined the staff of the Geology Department as an assistant professor of seismology, is in charge of installing the quake-detecting apparatus.

The University unit is the first of three seismograph stations in the State of Washington which, on completion in the spring of 1949, will help make the California-to-Alaska coast section one of the world's most highly observed earthquake areas, Prof. Goodspeed reports. Reports from the three Washington stations will be coordinated with those of stations in California, British Columbia, and Hawaii to locate quake centers thousands of miles away.

Iowa State College recently held formal opening ceremonies for a new laboratory designed to furnish research and teaching facilities in food processing and food technology. According to its director, R. G. Tischer, the laboratory equipment compares

favorably with any similar laboratory in the country. The two-story, 30' x 90' building includes storage space for holding foods from 65° below zero to 120° above zero, experimental freezers, automatically controlled incubators with recording devices attached, heat-processing retorts, a separate food evaluation laboratory, an analytical laboratory, an instrument room, classrooms, offices, etc.

At Northeastern University's 50th anniversary convocation on October 2, honorary D.Sc. degrees were conferred upon Edmund W. Sinnott, president of the AAAS and director of Yale's Sheffield Scientific School, and Percy L. Julian, director of research and manager of fine chemicals for the Glidden Company. Others receiving honorary degrees included Luis de Florez, Rear Admiral (USNR), consulting engineer and inventor, and Edwin R. Gilliland, professor of chemical engineering, Massachusetts Institute of Technology (Engineering); and James Bryant Conant and Raymond Walters, presidents of Harvard University and the University of Cincinnati, respectively (Laws).

An experiment in the field of cosmic radiation, the first of its kind ever made in Sweden, has just been carried out by a group of physicists from the University of Lund under the direction of Sten von Frisen. According to the American-Swedish News Exchange, 10 balloons, carrying containers with photographic plates, were sent up 70,000 feet into the stratosphere from Torslanda Airport, near Gothenburg. At least three of the containers have been found in neighboring provinces and are being examined at the Institute of Physics in Lund.

Industrial Laboratories

Kurt J. Heinicke recently joined the staff of Ward's Natural Science Establishment, Rochester, New York, as manager of a newly-formed Scientific Instrument Division. Dr. Heinicke was formerly associated with the Bausch & Lomb Optical Company in connection with their instrument development program.

Norris D. Embree, former associate director of research at Distillation Products, Inc., Rochester, New York, was recently appointed director of research. Dr. Embree joined the Research Department at Eastman Kodak in 1934 to work on a project which resulted in the establishment of D.P.I. as a separate company in 1939. The designing of high-vacuum pumps, his initial investigations, later led to the Embree jet, which formed one of the basic steps in modern high-vacuum pump development. For the past several years, Dr. Embree's efforts have included a vigorous program of vitamin research; in addition, he was responsible for the development of D.P.I.'s New Products Department.

Meetings and Elections

A Symposium on Medicolegal Problems is being sponsored by the Institute of Medicine of Chicago, the Chicago Medical Society, and the Chicago Bar Association, beginning Tuesday, October 26, at the Chicago Bar Association, 29 South LaSalle Street, Chicago. Meetings will be held on consecutive Tuesday evenings, with the exception of Thursday, December 2, at 7:30 P.M., preceded by dinner at 6:00 P.M. Among the topics to be discussed by authorities in both the medical and legal professions are: October 26, "Mental and Chronological Age Problems in Law and Medicine"; November 2, "Sex Offenses and Sex Offenders"; November 9, "Modern Methods of Crime Detection"; November 16, "Income Tax Discrimination Against the Professions"; November 23, "The Problem of Alcoholism: Medical and Industrial Aspects"; and December 2, "How Can the Constitutional Office of Coroner Serve Modern Needs?" All lawyers, physicians, students, and others interested in medicolegal problems are cordially invited to attend.

An Illinois Forestry Congress will be held October 28-29 at the University of Illinois, under the sponsorship of the Illinois Technical Forestry Association in cooperation with the University, according to J. N. Spaeth, general chairman. It is expected that the Congress will provide the first opportunity for all groups concerned with the timberland resources to consider

ways and means of developing the forests of Illinois to serve all their interests fully.

Speakers appearing on the program, together with their topics, are: Chester C. Davis, former director of Federal farm and economic programs, "Economic Opportunities in Proper Land Use"; Charles B. Shuman, Illinois Agricultural Association, "Forest Land Management in the Farm Program"; H. P. Rusk, College of Agriculture, University of Illinois, "Land Use Problems in Illinois"; F. W. Gottschalk, American Lumber and Treating Company, "Industry and Illinois' Forest Resources"; George Brooks, AFL, "Labor's Stake in Forest Land Management"; Kenneth A. Reid, Izaak Walton League of America, Inc., "Conservation in a Democracy"; Jay H. Price, U. S. Forest Service, "Responsibilities of a State in the National Forestry Program"; and A. G. Hall, American Forestry Association, "The Place of a State Forestry Association in Promoting an Adequate State Program." Congress meetings will be held in the auditorium of the University of Illinois and will be followed by a field trip to Allerton Park. The public is invited to attend. Reservations should be placed with R. W. Lorenz, 219 Mumford Hall, Urbana, Illinois.

The fall meeting of the **Indiana Academy of Science** will be held October 28-30 at Indiana University, Bloomington. Papers will be read in the 11 divisions of the Academy. Konrad Birkhang, of the Division of Laboratories and Research of the New York State Department of Health, will be guest speaker before the Bacteriology Section and will talk on "The Proper Place of BCG Vaccination in the Control of Tuberculosis." Winona Welch, of DePauw University, will give the presidential address. Her subject will be "Mosses and Their Uses."

The **Springfield Chapter of the AAAS** is holding a meeting on November 4 which will include an afternoon session (1:30 for students, 3:15 for teachers and students) and an evening session (8:15), both to be held at the Technical High School on Springfield Street. Wm. H. Ross, of Am-

herst College, and Cyril H. Brown, Tracerlab, will speak at the afternoon session. The evening meeting will feature a talk by Dr. Nims, of Braintree National Laboratory. Local members wishing to make reservations for the dinner preceding the evening session (Blake's, 6:15) may do so through Philip H. Cinis, 633 Chestnut Street, Springfield 7, Massachusetts.

The **American Association of Pathologists and Bacteriologists** has announced that its forthcoming annual meeting will be held in Boston, Massachusetts, April 15-16, 1949. Further information regarding the meeting may be obtained from the Association secretary, Howard Karsner, 2085 Adelbert Road, Cleveland, Ohio.

At the opening session of the **Congresso Nazionale dell'Unione Matematica Italiana** at the University of Pisa on September 23, two degrees *Honoris causa* were conferred. The recipients of these D.Sc. degrees were Elie Cartan, professor of Mathematics at the University of Paris, and Marston Morse, professor of Mathematics at the Institute for Advanced Study, Princeton, New Jersey. The presentation was made by the Minister of Public Education of Italy. Prof. Morse gave one of the three opening addresses of the Congress.

The **American Chemical Society Division of Petroleum Chemistry** has elected the following officers for the 1948-49 term: Wayne E. Kuhn, manager of the Technical and Research Division, The Texas Company, New York City, chairman; Arlie O'Kelly, associate director of research, Socony-Vacuum Oil Company, Paulsboro, New Jersey, vice-chairman; and Bernard H. Shoemaker, assistant research director, Standard Oil Company of Indiana, Whiting, Indiana, and L. U. Franklin, assistant chief chemist of the Gulf Oil Corporation, Port Arthur, Texas, new members of the Executive Committee. Chalmers H. Kirkbride, laboratory director of the Houdry Process Corporation, Pennsylvania, Marcus Hook, was re-elected secretary-treasurer.

The Genetics Society of America recently elected for following officers to serve for the 1949 term: T. M. Sonneborn, Indiana University, president, and Curt Stern, University of California, vice-president. M. R. Irwin, of University of Wisconsin, will continue to serve as secretary-treasurer.

Deaths

William F. Hand, 74, emeritus dean of the School of Science and professor of chemistry at Mississippi State College, died at his home in State College, Mississippi, on September 25, following a long illness. At the time of his death Dr. Hand was serving as vice-president of Mississippi State.

Joseph A. Ambler, 59, organic chemist at the Southern Regional Research Laboratory, died October 6 in New Orleans, Louisiana. Dr. Ambler had served with the USDA for 31 years.

Horace Terhune Herrick, 61, a leading authority on the industrial utilization of agricultural commodities, and special assistant to the chief of the Bureau of Agricultural and Industrial Chemistry, USDA, died at his home in Washington, D. C., October 7.

Construction has begun on the **Clinical Center of National Institutes of Health** to be located at Bethesda, Maryland, and it is hoped that the building will be completed within 3 years. The 13-story building will house the National Institute of Mental Health and hospital facilities of the National Cancer Institute, the National Heart Institute, and the National Institute of Dental Research, as well as services for studying patients with infectious and tropical diseases. Thus, there will be combined within a single structure both hospital and laboratory facilities, including the usual features of a 500-bed general hospital together with medical and psychiatric social service, physical and occupational therapy, and rehabilitation services. Patients from all parts of the country will be referred to the clinical center by physicians, hospitals, and other health agencies on the basis

of problems being studied at various times. The scientific laboratories will occupy two-thirds of the building. In the planning and construction of the building the advice and guidance of many of the most prominent hospital experts, architects, and scientists have been sought; consequently, the new building will be of ultramodern design, entirely air-conditioned, and will have a two-corridor plan permitting close relationship between clinical care and investigative areas. The Center will collaborate closely with other government and voluntary agencies in a concerted attack on chronic diseases.

Standard strains of the tubercle bacillus are being supplied to qualified investigators in all parts of the world through a Culture Bank maintained by the National Tuberculosis Association at the Trudeau Laboratory, Trudeau, New York. This service, provided as part of NTA's medical research program, is designed to encourage scientists to use strains of known origin, type, and virulence. Since the Bank was established in 1946, requests from 18 foreign countries and various parts of the United States have been filled.

"Our Presidents and Science" is the title of a display set up at the Library of Congress in celebration of the first 100 years of the AAAS. No President is represented by fewer than two items indicating the connection which existed between each Chief Executive and the advancing science and technology of his day. Foremost of the Presidents with individual scientific achievements was Thomas Jefferson. Among the Jefferson pieces on display are a notebook kept by him at Monticello for over 44 years and containing meteorological and other scientific observations; a paper which he read before the American Philosophical Society in 1797, dealing with an extinct giant sloth; a broadside amplifying his invention of a mould board, an improvement in the plough; and his detailed contribution to American geography, *Notes on Virginia*, published in London in 1787. Other Presidents in this group include George Washington, who was interested in scientific agriculture; John Quincy Adams, whose voluminous *Report on*

weights and measures (1821) is exhibited; William Henry Harrison, who contributed to the field of archeology through publication of his *Discourse on the Aborigines of the Valley of the Ohio* (1838); Theodore Roosevelt, practical naturalist and explorer; and Herbert Hoover, distinguished mining engineer and author of a textbook, *Principles of mining*.

This most interesting exhibit will be open to the public until the end of November.

Fossil remains of clawed creatures, probably relations of the remote ancestors of hoofed animals, were obtained this summer by Charles L. Gazin, curator of Vertebrate Paleontology at the Smithsonian Institution, from deposits in western Wyoming. Dr. Gazin also found in these Eocene deposits an excellent skull of *Hyracotherium*, the "drawn horse," which, although the size of a small dog, belongs in the general ancestral line of the horses. Near Pipestone Springs, Montana, he collected bones of small mammals of the so-called Oligocene geological period, including those of primitive rodents, carnivores, and insectivores. All of the specimens collected will be added to the paleontological collections of the U. S. National Museum.

Make Plans for—

National Committee for Mental Hygiene, 39th annual meeting, November 3-4, Hotel Pennsylvania, New York City.

American Institute of Electrical Engineers, November 3-5, Birmingham, Alabama.

Symposium on "Yeasts in Feeding," November 8-10, Hotel Pfister, Milwaukee, Wisconsin.

American Public Health Association, 76th annual meeting, November 8-12, Boston, Massachusetts.

National Academy of Sciences, autumn meeting, November 15-17, University of California, Berkeley.

American Oil Chemists' Society, fall meeting, November 15-17, Pennsylvania Hotel, New York City.

Comments and Communications

Resignation of Professor Muller From Academy of Sciences of the USSR

The following letter, dated September 24, 1948, was sent by H. J. Muller, of Indiana University, Nobel Prize winner and past president of the Genetics Society of America, to the President, the Secretary, and the Membership of the Academy of Sciences of the USSR:

"In February 1933 the Academy of Sciences of the USSR sent me a diploma, signed by its venerable President, Karpinsky, and its Secretary, Volgin, stating that I had been elected a 'Corresponding Member.' In accepting this election, I realized that it was a signal honor, inasmuch as your Academy had a long and most distinguished tradition of scientific achievement and integrity, and was still maintaining its high standards and, in fact, greatly expanding its valuable work. Although for nearly a decade I have not been sent your publications, I must presume that I am still on your rolls, since I have received no information to the contrary.

"The deep esteem in which I have held your organization in the past makes it the more painful to me to inform you that I now find it necessary to sever completely my connection with you. The occasion for my doing so is the recently reported series of actions of your Presidium in dropping, presumably for their adherence to genetics, such notable scientists as your most eminent physiologist, Orbeli, and your most eminent student of morphogenesis, Schmalhausen, in abolishing the Laboratory of Cytogenetics of your most eminent remaining geneticist, Dubinin, in announcing your support of the charlatan, Lysenko, whom some years ago you had stooped to take into your membership, and in repudiating, at his insistence, the principles of genetics. These disgraceful actions show clearly that the leaders of your Academy are no longer conducting themselves as scientists, but are misusing their positions to destroy science for narrow political purposes, even as did many of those who posed as scientists in Germany under the domination of the Nazis. In both cases the attempt was made to set up a politically directed 'science,' separated from that of the world in general, in contravention of the fact that true science can know no national boundaries but, as emphasized at the recent meeting of the American Association for the Advancement of Science, is built up by the combined efforts of conscientiously and objectively working investigators the world over.

"In Germany too it was the field of genetics, that of my own specialization, which was subjected to the greatest perversion, as I pointed out in publications and lectures gotten out both shortly before and during several years after the Nazi coup. And in the USSR the pre-scientific obscurantism of Lysenko, supported by the so-

called 'dialectical materialism' represented by Presentists with their faith in the inheritance of acquired characteristics must lead inevitably, and indeed by the admission of some of their adherents, to the same dangerous Fascistic conclusion as that of the Nazis: that the economically backward peoples and classes of the world have become actually inferior in their heredity. The Nazis would have the allegedly lower genetic status a cause, while the Lysenkoists would have it an effect, of the lower opportunities of the less fortunate groups for mental and physical development, but in either case a vicious circle is arrived at, which objective geneticists do not concede. Objective geneticists, on the contrary, having established the existence of a separate material of heredity, which is not influenced in any corresponding way by modifications of the phenotype, or bodily characteristics of organisms, recognize the fallacy of judging the hereditary endowments either of individuals or of whole groups simply by outward appearances. Especially is this the case when, as with human mental traits, there are very variable environmental influences, such as differences in traditional education, nutrition, etc., which have pronounced and systematic effects upon the development of these characteristics.

"In truth, genetics is so fundamental and so central to all fields of biological science, and even of social sciences and philosophy, that the excision of its established principles from the body of science as a whole cannot but result in the eventual debilitation and falsification of our understanding of things in general. Even the physical sciences must in the end be adversely affected by the admission of the naive and archaic mysticism of Lysenko's Present, and their group into the vacuum left by the removal of genetics, for processes must then be invoked which are contradictory to the workings of matter.

"Under the circumstances above set forth, no self-respecting scientist, and more especially no geneticist, if he still retains his freedom of choice, can consent to have his name appear on your list. For this reason I hereby renounce my membership in your Academy. I do so, however, with the ardent hope that I may yet live to see the day when your Academy can begin to resume its place among truly scientific bodies.

"The importance of the matters here at issue—including that of the authoritarian control of science by politicians—is in my opinion so profound that I am making this letter public."

On "Animal Hypnosis"

In reference to W. T. Liberson's paper, "Prolonged Hypnotic States With 'Local Signs' Induced in Guinea Pigs" (*Science*, July 9, pp. 40-41) I would like to call attention to the following points:

The basis of the theory of animal hypnosis is the fact that many animals may be "hypnotized" by retaining them in uncomfortable positions. Granted that there are many phenomena that may be reproduced in the laboratory animals that closely resemble hypnosis, the fact remains that this theory is quite generally accepted as being erroneous. Both Verworn and Hull have proved that

conclusively that "animal hypnosis" due to placing animals in unaccustomed and inconvenient situations is a tonic recumbency reflex. Verworn assumed that this inferred that there was no psychological basis for "animal hypnosis." In this belief he was incorrect; however, in his assumption that this was not a true state of hypnosis, he was entirely correct, as was later confirmed by Clark Hull.

Dr. Liberson has produced an interesting paper on tonic recumbency reflexes but is extremely misleading in his terminology.

ROBERT M. TRUE

Brunswick Hospital, Brunswick, Maine

Dr. True raises the question of terminology in regard to my note published in the July 9 issue of *Science*. The term "animal hypnosis" which I used has been employed in the past by a great number of scientists, among them Steininger, Babak, Reisinger, Rijland, and Pavlov, without implying the identity of this condition to human hypnosis. The term "tonic recumbency reflex" suggested by Dr. True is not satisfactory, first, because the animals I studied often presented clonic and agitated reactions, and second, because this term does not imply the presence of concomitant psychological phenomena which Dr. True, himself, believes to be a factor associated with immobilization. The suggested term is, furthermore, irrelevant in regard to the phenomena which I described, as they may be observed in an animal in the upright position. His contention that retaining the animal in an uncomfortable position or "placing animals in unaccustomed and inconvenient situations" is the basis for "animal hypnosis" is not supported by my experiments, at least as far as prolonged hypnotic states are concerned. Indeed, I showed that by the mechanisms of conditioning and frustration the prolonged "hypnotic" reactions may be observed when the animal is put on one side and fail to appear when it is put on the opposite side in the same uncomfortable position.

The importance of the training apparently completely escaped the attention of Dr. True. It is the alleged impossibility of forming an hypnotic habit in the animals which was one of the decisive arguments of Hull and others to deny this state the name of hypnosis, while one of the main findings reported in my note dealt precisely with the possibility of training a prolonged animal hypnotic state.

When the same name is applied to a phenomenon described in both man and animals, this term is never equally applicable to both situations. We speak of intelligence in considering simple maze problems for low mammals as well as in discussing the masterpieces of human genius. In the same way, we should not expect the term "animal hypnosis" to have the same characteristics as "human hypnosis." As this term has been equally applied to man and to animals, the purpose of a scientist is to determine the underlying mechanisms of these states in various species and to reveal their simi-

larities and differences. The question of terminology then becomes secondary.

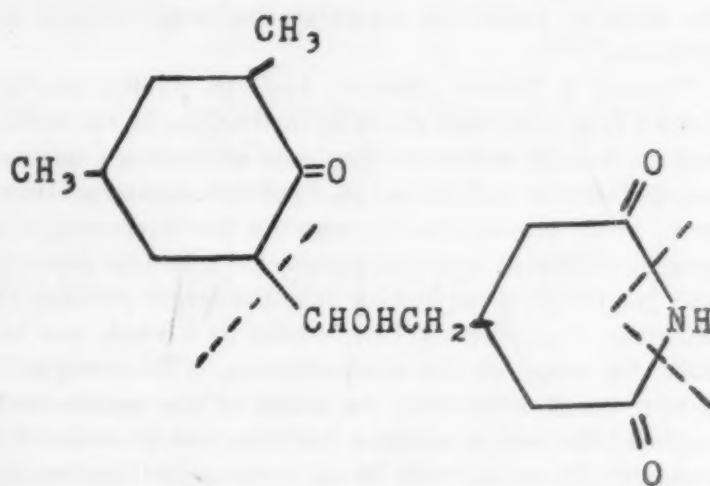
W. T. LIBERSON

Hartford, Connecticut

The Structure of Actidione, An Antibiotic From *Streptomyces griseus*

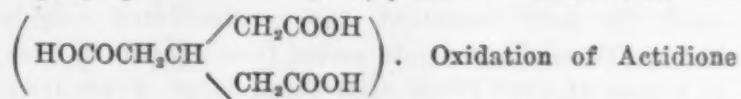
Recently Ford and Leach (*J. Amer. chem. Soc.*, 1947, 69, 474; 1948, 70, 1223), of the Upjohn Research Laboratories, reported the isolation of a new antibiotic substance from *Streptomyces griseus* which they named "Actidione." This interesting material is highly active against almost all yeasts but is relatively innocuous to other microorganisms. Subsequently, Leighty and Fortune, of these laboratories, also isolated this substance from streptomycin residues, and we undertook a study designed to elucidate the chemical structure of the new antibiotic.

Actidione has the empirical formula $C_{15}H_{22}NO_4$. It has one hydroxyl and only one ketonic group. Evidence based on various chemical degradations and transformations, together with that derived from physical studies, leads us to propose the structural formula I for Actidione.



I

On alkaline hydrolysis the molecule is split, as indicated by the dotted lines, into three products: (1) ammonia, (2) a fragrant, optically active ketone ($C_8H_{14}O$) which was identified as 2,4-dimethylcyclohexanone, and (3) a 7-carbon acid fragment, presumably 3,3-propionaldehydediacetic acid. This latter substance has not as yet been obtained in a pure condition, but solutions containing it, upon mild oxidation, yield methanetriacetic acid



Oxidation of Actidione yields a diketone, dehydroactidione ($C_{15}H_{20}NO_4$), which on alkaline hydrolysis is degraded to ammonia, 2,4-dimethylcyclohexanone, and methanetriacetic acid. Electrometric titration of the antibiotic shows the presence of a weakly acidic group with a $pK=11.2$ (glutarimide likewise has a $pK=11.2$). Catalytic reduction gives dihydroactidione ($C_{15}H_{22}NO_4$), which reacts with diazo-

methane to give *N*-methyldihydroactidione ($C_{16}H_{27}NO_4$). These facts and other transformations are best interpreted on the basis of the proposed structure I.

A detailed account of the work will be reported in a forthcoming publication.

E. C. KORNFIELD and R. G. JONES

*The Lilly Research Laboratories,
Indianapolis, Indiana*

Present Distribution of Medical Research Funds by Governmental Agencies

In my former communication on "Distribution of American Research Funds" (*Science*, February 6, pp. 127-130) primary emphasis was laid on the seemingly undue concentration of such research grants in the northeastern section of the country (states bordering the Atlantic Ocean from the District of Columbia northward). The regional and institutional inequalities in distribution were related principally to institutional representation on disbursing or advisory committees. Data presented in that first article dealt mainly with grants made by private and semiprivate foundations, although one U. S. Public Health report showed a fairly equitable geographic distribution of almost \$2,000,000. Even there, however, the evils of committee representation were strongly in evidence.

Thomas B. Turner (*Science*, April 16, p. 391) has defended this favoritism shown to institutions of the northeastern coastal states on the basis of their greater research facilities and trained staffs of investigators. However, Prof. Turner frankly restricts his interest to the present ability of such institutions to prosecute research and get things done, stating that the larger problem of scientific development of the country as a whole was beyond the scope of his communication. No thoughtful person would doubt that the states of the northeastern seaboard do possess superior facilities and personnel for research; otherwise, there would exist no justification for all the funds which have been poured into them through past decades.

Scientific development of the country as a whole is of much greater importance through the decades ahead, however, and should transcend petty regional jealousies and rivalries for funds available. Since no National Science Foundation has yet been established by Congressional action, let us look further into the distribution made by certain governmental agencies which are attempting to stimulate and support medical research over the country. Of these agencies, the U. S. Public Health Service is easily the most important, having distributed roughly \$10,000,000 in the 20-month period from January 1, 1946, to August 31, 1947 (*Publ. Hlth Reps.*, Suppl. #205, January 1, 1948). Careful analysis of this sum's distribution in the form of some 700 research grants yields the following pertinent data:

Excluding from consideration 17 grants made to national associations or to individuals whose whereabouts could not be determined, we find that 294 grants (or 43% of the total number) went to recipients in the northeast-

ern area, which holds only 30% of the country's population, as against 389 (or 57%) over the remainder of the country. This 43% of the total number of grants brought to this small northeastern area 47% of all funds distributed. There were 67 institutions or individual recipients in the Northeast and 91 elsewhere, grants to the former averaging \$15,400 each and those to the latter \$13,100.

Johns Hopkins, Harvard, Columbia, and New York Universities and the University of Pennsylvania head the list of recipients, constituting 5 of the 6 highest. These 5, plus Cornell, received 65% of all funds distributed to the northeastern area, while the highest 6 in the remainder of the country (the Universities of Chicago, Utah, Minnesota, Michigan, and California, and Washington University in St. Louis) received 39% of that area's funds. Although the Public Health Service did not this time publish the names of scientists serving on its lists of advisory panels, the similarity in distributional characteristics leads one to suspect the same relationship of committee representation and recipient rating as was set forth in my earlier article.

In grouping the U. S. Public Health Service grants according to institution where the work was to be performed, a number of grants made in the name of an individual were considered as made to the institution where the individual in question was known to be closely associated thereto.

One additional government granting agency for which partial data have been supplied is the Medical Sciences Division of the Office of Naval Research. In its list of universities and nonprofit organizations in which fundamental research is being supported, 39 are found located in the northeastern coastal area and only 38 scattered over the remainder of the country. New York, Massachusetts, and Pennsylvania lead the list in numbers of institutions receiving support, with 12, 8, and 6, respectively. Numbers of different projects supported in each institution were not given, nor were the sizes of grants specified.

It thus seems evident that governmental agencies—probably influenced by the constitution or their advisory panels of scientists—are still reflecting the past dominance of the northeastern seaboard in scientific matters. It also seems evident that there exists serious need of a National Science Foundation, if the scientific potential of all areas of the Nation are to secure equitable chances for development. Any legislation setting up such a Foundation should specifically require its membership to be drawn from all areas of the Nation and its benefits to be distributed so as to achieve maximal scientific development in all areas of the Nation. To leave selection of Foundation members to presidential or political whim may end in the same disproportionate distribution that has just recently occurred under the Smith-Mundt Bill. Of the 5 members of the Educational Exchange Commission recently appointed under that Bill, four are from the northeastern coastal area and only one from the remainder of the country!

CLARENCE A. MILLS

University of Cincinnati

TECHNICAL PAPERS

Ionic Exchange Equations Derived from Statistical Thermodynamics

C. KRISHNAMOORTHY, L. E. DAVIS, and R. OVERSTREET

*Division of Soils,
University of California, Davis*

Ionic exchange systems at equilibrium consist of two phases: an aqueous phase, which may be a filtrate or centrifugate, and an adsorbent phase, which is the solid exchanger. Equilibrium states may be defined in terms of equations which represent the distribution of ionic species between the two phases. Many of the theoretical expressions which appear in the literature have the form of mass action equations. We may postulate that such expressions are well defined thermodynamically when the terms employed consist of ratios of appropriate powers of so-called ionic activities.

We cannot directly measure the activity values in the adsorbent phase. Special working hypotheses can be tested. The usual test employed is invariance of the equilibrium "constant" when concentrations are varied. Kerr (3) and others have assumed tacitly or specifically that the ionic activities are equal to the concentrations of the exchanging ions in the adsorbent phase. Vanselow (4) has shown that this assumption does not generally lead to invariant values of the exchange constant. This is particularly true for univalent exchanges when the amount of exchanger is varied. Vanselow proposed the hypothesis that ionic activities of ions in the adsorbed state are equal to mol fractions. In many cases more consistent results were obtained when this hypothesis was employed.

Recently Davis has adopted a method first presented by Fowler and Guggenheim (1) and applied by them to equilibrium adsorptions of mixed gases on surfaces. Each gas molecule is assumed to be adsorbed onto one site on the surface. Guggenheim (2) has extended the discussion to include cases in which certain molecules occupy more than one site. The activities of the adsorbed species are related to the number of mols by equations which can be derived from a relatively simple statistical mechanics.

This procedure can be applied to ionic exchange "adsorption" states with a slight modification of the basic assumptions utilized by Fowler and Guggenheim. Each adsorbed ion is present in a quasi-ideal monolayer. The nature of the forces or bonds is irrelevant except that the partition function must be independent of the ionic distribution. This is probably true for completely dissociated ions, but not, apparently, for hydrogen and perhaps other ions. The ions interact electrostatically. However, unless the interaction is specific, it will not

vary with the relative amounts of the ionic species, since the total number of adsorbed elemental charges per unit area of monolayer is invariant. (There are no unoccupied sites.) This condition is equivalent to the assumption utilized by Guggenheim that the energy of mixing is zero.

The derivation will not be presented here, but the final expression is shown as equation (1). The authors have assumed herein that each site on the adsorbing surface has four nearest neighboring sites. In equations (1) and (2), terms in brackets represent numbers of mols of replaceable ions in the adsorbent phase, Z . Terms in parentheses represent "ionic activities" in the aqueous phase. For a system containing in the aqueous and adsorbent phases the ionic species A, B, C, D, . . . of valencies $r_1, r_2, r_3, r_4, \dots, r_n$, the equilibrium for the exchange reaction of any pair, say A and B, is given by the expression:

$$k_{(A,B)} = \frac{[A]^{r_2}}{[B]^{r_1}} \cdot [q_1 A + q_2 B + q_3 C + \dots]^{r_1 - r_2} \cdot \frac{(B)^{r_1}}{(A)^{r_2}} \quad (1)$$

where $q_n = \frac{r_n + 1}{2}$ for the assumption that each site on the absorbing surface has four neighboring sites.

For a system containing La, Cs, and H, equation (1) reduces to

$$k_{(La,Cs)} = \frac{[La]}{[Cs]^2} \cdot [Cs + H + 2La]^2 \cdot \frac{(Cs)^2}{(La)} \quad (2)$$

The presence of variable amounts of H in systems with varied concentrations of the three ionic species may invalidate to some extent the assumption that interaction is invariant. However, when H is not one of the reacting pair A and B, the effect is indirect and possibly not important to a first approximation.

Equation (2) has been tested experimentally with clays and synthetic resins by Krishnamoorthy and Overstreet. The results for the synthetic resin IR 100 are presented below:

	[La]	[Cs]	[H]	(La)	(Cs)	$k_{(La,Cs)}$ (Equation 2)
1	.174	.692	.520	1.5×10^{-3}	.324	345
2	.345	.373	.330	2.33×10^{-3}	.389	385
3	.407	.110	.370	.114	.398	385
4	.433	.090	.300	.258	.418	379
5	.094	.036	.100	.073	.472	355
6	.167	.182	.230	1.5×10^{-3}	.326	357
				Avg.		367 ± 14

All quantities in the table are expressed as millimols/100 cc, and the constant $k_{(La,Cs)}$ has been corrected for activity coefficients of ions in the aqueous phase. An extension of Guggenheim's theory is being applied to a

variety of systems. The results will be published elsewhere.

References

1. FOWLER, R. H., and GUGGENHEIM, E. A. *Statistical thermodynamics*. New York: Macmillan, 1939.
2. GUGGENHEIM, E. A. *Proc. roy. Soc. Lond.*, 1944, **183A**, 203.
3. KERR, H. W. *Soil Sci.*, 1928, **26**, 385.
4. VANSELOW, A. P. *Soil Sci.*, 1932, **33**, 95.

Cleavage Patterns Disclose "Toughness" of Metals¹

C. A. ZAPFFE, C. O. WORDEN, JR., and
F. K. LANDGRAF, JR.

6410 Murray Hill Road, Baltimore, Maryland

A recent communication in this journal (1) called attention to the microscope technique referred to as "fractography," particularly with respect to its usefulness in disclosing subtle structural deformities within crystals relating to their history and mechanism of growth.

Now it is found that the cleavage patterns studied by fractography similarly contain marked features directly related to the "toughness" of the crystal. In the case of engineering materials, particularly metals, "toughness" is a most important property, and one which has escaped satisfactory measurement to date. That is, values for tensile strength were long ago found to be inadequate as a measure of structural stability if the material was stressed nonaxially, such as by bending or by lateral impact, and auxiliary values for ductility, hardness, and impact resistance were subsequently added to specifications. Experience during the recent war, however, emphasized the fact that the true measure for "toughness" still does not stand among any of these values. A phenomenon in point is that in which apparently identical steels used for ship-plate served in a satisfactory manner in one case, but in the other failed suddenly, and often disastrously, in a brittle fashion, indicating some radically inferior property of the metal not yet recognized. Among these experiences are some 4,000 reported failures on welded ships, some 40 of the vessels having broken completely in two.

Recently it has been determined by metallurgists working on the problem, principally under the sponsorship of the U. S. Navy, that this difference in "toughness" can be demonstrated in the laboratory by conducting certain standard tests over a range of temperature—for example, fracturing by impact a series of notched specimens at progressively lowered temperatures. The energy absorbed by the specimen commonly has an acceptably large value when fractured in the high range of ordinary temperatures; but, as the temperature lowers toward and into the freezing range, certain steels rapidly lose their resistance to fracture. The narrow temperature range in which this defection appears is currently referred to as the "transition temperature"; and the phenomenon

¹ From research conducted in the laboratory of the senior author under contract with the Office of Naval Research.

shows simultaneously as a loss in resistance to propagation of fracture, a failure of the crystal's slip elements to provide the malleability which characterizes good metal, and a change in the macro-appearance of the fracture surface from ductile-fibrous to brittle cleavage.



FIG. 1. Pattern of "toughness." A cast steel containing 7.70% chromium and 0.10% carbon, air-cooled from 875° C to produce martensite ($\times 2,000$).

In this laboratory the cleavage facets of individual grains within structural steels have been examined at high magnification; and the discovery of a cleavage pattern having marked relationships with "toughness," as determined both by mechanical testing and by actual use, provides the basis for this communication.

The cleavage facet shown in Fig. 1 is in a martensite structure, which is known to be "tough." The pattern accordingly discloses a rough surface visibly indicating an almost continuous interruption of cleavage travel.

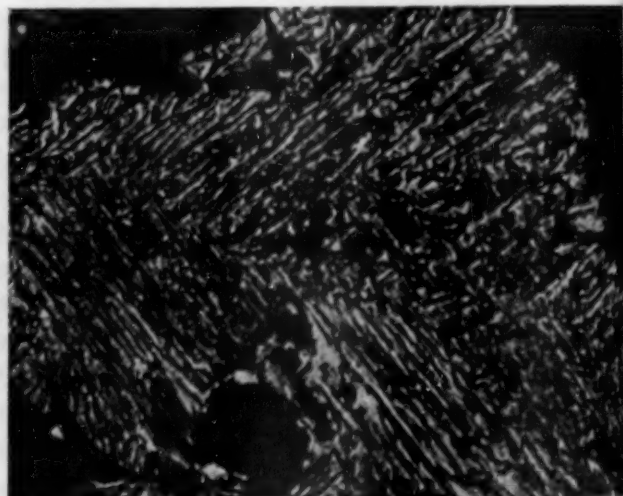


FIG. 2. Pattern of weakness. Type 446 stainless steel, containing 26% chromium and 0.15% carbon, water-quenched from 850° C and embrittled by heating for 200 hrs at 475° C ($\times 850$).

Crystallographic markings are absent. The grain size is also small, imposing an additional hindrance by requiring frequent change in the general plane of travel as the separation proceeds from grain to grain. In this steel, cleavage is therefore resisted both transgranularly and intergranularly.

The fractograph of another chromium-containing steel (Fig. 2) shows a markedly different pattern. This is

steel notoriously lacking in "toughness." The cleavage traverse here is relatively flat and uninterrupted across the entire grain; the grain is relatively larger than the preceding, thereby reducing the factor of grain-boundary resistance; and crystallographic markings, particularly at

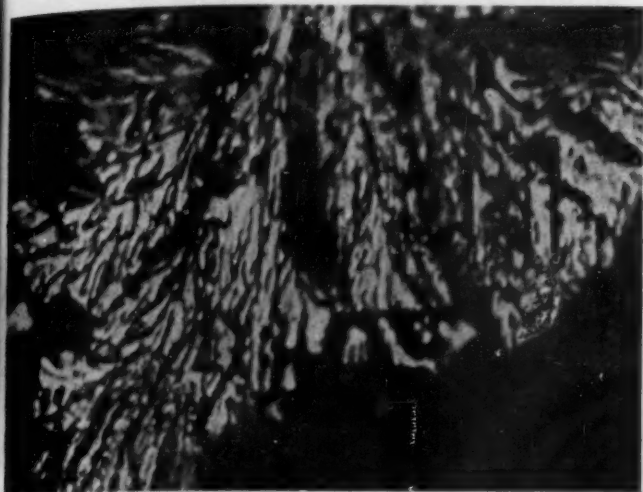


FIG. 3. Pattern of "toughness." Standard unalloyed Steel Q from Navy tests, known to be relatively tough for steel of its class ($\times 1,250$).

are in strong evidence. This is accordingly a pattern of cleavability, or weakness—specifically, a low resistance to notch-impact.

Transferring attention now to unalloyed steel, one finds in Figs. 3 and 4 the fractographs of two of the standardized mild steels widely studied with respect to their serviceability for ship-plate. In Fig. 3, Steel Q, which contains 0.22% carbon, 1.13% manganese, and 0.05% silicon, shows a "toughness" pattern suggestive of that shown in Fig. 1. In this case the "toughness"

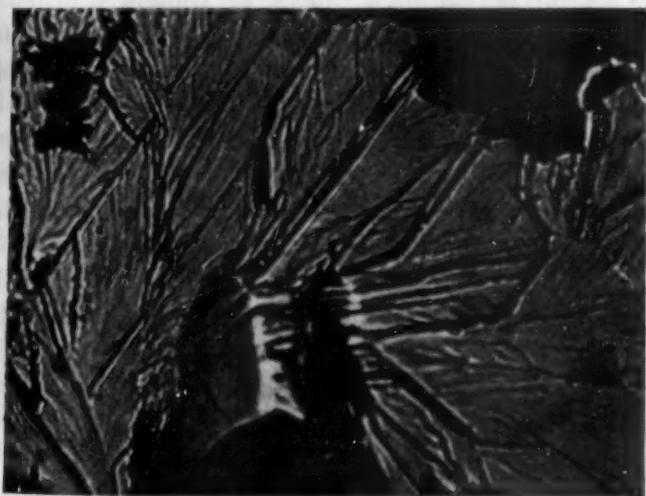


FIG. 4. Pattern of weakness. Standard unalloyed Steel E from Navy tests, similar in composition to Steel Q, but known to lack toughness ($\times 975$).

has also been similarly derived, by heat treating in a manner to produce martensite.

In conformity with the information in the fractograph, mechanical testing of this steel in other laboratories has proved it to be "tough" relative to other steels of its kind. A relatively low temperature is required for transition from a tough fracture to a brittle one.

A fractograph of the standard Steel E (Fig. 4) shows a

decidedly different pattern, more in keeping with the pattern in Fig. 2. It is similar in composition to Steel Q, except for a manganese content of only 0.33%; but it differs considerably in structure in that its condition is "as-rolled"—hence, not martensitic. The cleavage traverse is flat, expansive, and but little interrupted, and crystallographic markings are much in evidence. In conformity with this fractographic indication of inferior cleavage characteristics, Steel E is known to compare poorly with Steel Q, experiencing transition from tough to brittle cleavage at such relatively high temperatures that it prohibits recommendation for the types of service in question.

These patterns, of course, are strictly comparable only among materials of a defined class. Other fundamental factors—specifically, alloy content—greatly influence strength and toughness; and a pattern for mild steel cannot be compared directly with one for an alloy steel, as a rating of toughness, without taking into account the fundamental difference in atomic cohesion. As will be shown in a report soon to be issued, an alloy steel with an unfavorable cleavage pattern may still show greater toughness than an unalloyed steel with a favorable pattern, simply because the atomic matrix of the alloy steel is more strongly coherent.

Perhaps the principal importance of the evidence stands in its demonstration of an active structural factor within the individual grain which impedes cleavage in one case much more strongly than it does in another, and which therefore accounts for subtle differences, not previously understood, among structural materials of a given class.

Reference

1. ZAPFFE, C. A., LANDGRAF, F. K., JR., and WORDEN, C. O., JR. *Science*, 1948, 107, 320-321.

Deposition of Protein in the Liver Following Intravenous Injection of an Amino Acid Mixture (Hydrolyzed Protein) and Glucose¹

CHARLES A. ROSS and ROBERT ELMAN

Department of Surgery, Washington University Medical School and Barnes Hospital, St. Louis, Missouri

Although tissue protein is normally synthesized from food protein, there has been no demonstration by direct *in situ* study that this is possible with an amino acid mixture injected intravenously as the sole source of protein food. Chemical and histological evidence was reported from this laboratory (2) that protein is deposited in the cytoplasm of protein-depleted hepatic cells by the administration of a high protein diet by mouth. Evidence is presented herewith to show that the same

¹ Aided by a grant from the Commonwealth Fund.

is true when all the food is administered intravenously, the nitrogenous nourishment consisting of an amino acid mixture.

Six experiments were carried out on adult dogs weighing about 10 kg and in good nutritional condition. A control period of protein deprivation was carried out for 2 weeks by giving a 20% solution of sucrose by mouth in amount to supply 50 cal/kg of body weight/day. All animals drank this solution without difficulty. Each animal received an adequate amount of vitamins in capsule form each day.

TABLE 1

Dog	Date	Procedure and intake	Body wt (kg)	Hepatic nitrogen (% of wet wt)	Wt of liver (gm/kg of initial body wt)
A 8	Mar. 24	Control depletion	10.9	...	...
	Apr. 6	Biopsy	9.8	2.72	...
	Apr. 12	Autopsy (glucose alone)	9.3	2.75	31.2
A13	Apr. 13	Control depletion	9.1	...	...
	Apr. 27	Biopsy	8.2	2.96	...
	May 3	Autopsy (glucose alone)	7.5	2.84	32.9
A 9	Mar. 24	Control depletion	7.7	...	...
	Apr. 6	Biopsy	6.8	2.26	...
	Apr. 12	Autopsy (sucrose alone)	6.6	2.42	29.6
A10	Mar. 31	Control depletion	9.1	...	...
	Apr. 13	Biopsy	8.2	2.59	...
	Apr. 19	Autopsy (glucose + amino acid mixture)	8.7	3.12	35.1
A11	Mar. 31	Control depletion	10.4	...	...
	Apr. 13	Biopsy	9.8	2.73	...
	Apr. 19	Autopsy (glucose + amino acid mixture)	9.5	3.17	37.1
A14	Apr. 20	Control depletion	8.9	...	...
	May 4	Biopsy	8.2	2.58	...
	May 10	Autopsy (glucose + amino acid mixture)	8.2	2.91	38.6

At the end of this 2-week period the liver was biopsied under Nembutal anesthesia, a portion being used for microscopic study and the rest analyzed for its nitrogen content. Half, or 3, of the animals were maintained during the following week on carbohydrate alone, two of them by the injection of 10% glucose intravenously and one by 10% sucrose by mouth. The dose was 100 cc/kg of body weight/day. The other 3 animals received intravenously the same amount of solution, which contained, however, 5% of an amino acid mixture in 5% glucose. The amino acid mixture was a protein hydrolysate containing about 30% peptides and was made by the enzymic digestion of casein by pork pancreas (Amigen). The dogs given the amino acid mixture received 5 gm or 600 mg of nitrogen/kg/day. All intravenous injections were given at the same rate of 16 cc/kg/hr. Salt was added to the glucose solution so that the electrolyte intake was similar in the two groups.

At the end of the experiment all animals were sacrificed 2 hrs following the last injection. The entire liver was carefully removed and weighed, sections were studied

microscopically, and the nitrogen concentration measured. All animals were weighed at the start and at intervals during the experiment. Nitrogen determinations were made by the traditional macro-Kjeldahl procedure on a wet sample of the liver. Microscopic sections were carefully cut at 8 μ and stained with hematoxylin and eosin.

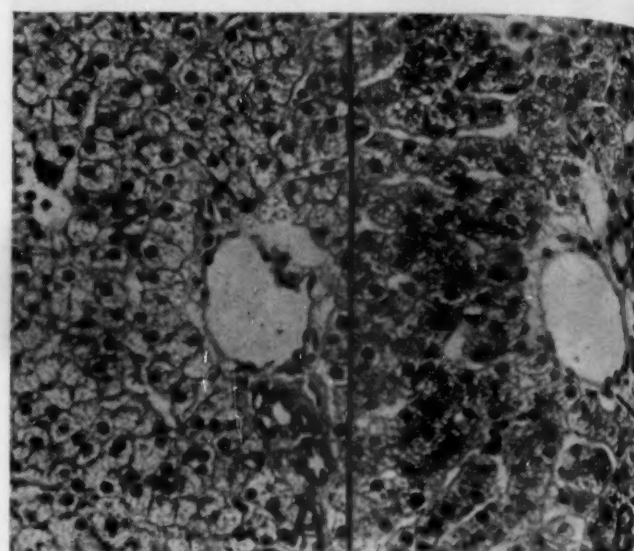


FIG. 1. Photomicrograph ($\times 240$) of the liver surrounding a central vein; specimen obtained at autopsy at end of experiment: A—control dog receiving intravenous glucose only, B—experimental dog receiving intravenous glucose plus an amino acid mixture (Amigen). Note in A the vacuolated cells and completely obliterated sinusoids, which is characteristic of the protein-deficient liver. (Nitrogen content, 2.42 gm %.) In B, by contrast, note the well-stained cytoplasm and normal sinusoids characteristic of the liver in a normal, well-fed animal. (Nitrogen content, 3.17 mg %.)

As shown in Table 1, all animals lost weight during the control period of 2 weeks of protein deprivation. The 3 dogs that received only carbohydrate during the third week continued to lose weight, whereas the 3 dogs that received intravenous protein hydrolysate either maintained their weight or showed a slight gain. The nitrogen content of the liver in the dogs on a carbohydrate intake alone, during the third week, changed very little ($+0.02\%$), as shown by comparing the analysis of the biopsy specimen with that obtained at autopsy. By contrast, all of the animals receiving the protein hydrolysate showed an increase averaging $+0.43\%$. The weight of the liver at death also showed a difference between the two experimental groups. The livers of the group receiving carbohydrate alone weighed 29.6, 31.2, and 32.9 gm/kg of initial body weight. The comparable figures in the 3 dogs receiving intravenous protein hydrolysate were 35.1, 37.1, and 38.6. The average difference was 31.2 as compared with 36.9.

Microscopic sections of the biopsied liver at the end of the control period in all 6 experiments showed the vacuolated, clear cytoplasm (1, 2) which is characteristic of protein depletion in the presence of an adequate carbohydrate intake. At the end of the experimental period, however, there was a definite difference in the appearance of the liver of the animals receiving intravenous glucose alone as compared with those receiving glucose and

hydrolyzed protein. The difference is shown in one typical experiment illustrated in Fig. 2. The presence of stainable cytoplasm in the liver of the animal receiving hydrolyzed protein is striking and is similar to previous studies in which this same change was observed following the ingestion of protein nourishment by mouth (2).

It would seem, from the observations reported here, that the intravenous injection of an amino acid mixture (hydrolyzed protein) leads to a deposition of tissue protein in the liver.

References

1. ELMAN, R., and HEIFETZ, C. J. *J. exp. Med.*, 1941, **73**, 417.
2. ELMAN, R., SMITH, M. G., and SACHAR, L. A. *Gastroenterology*, 1943, **1**, 24.

Radical Reactions With Certain Nitrogen Compounds: The Conversion of Benzene (Toluene, etc.) in Other Compounds at Low Temperature

OSKAR BAUDISCH

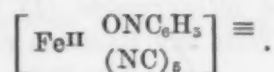
New York State Research Institute of the Saratoga Spa, Saratoga Springs, New York

The conversion of benzene with nitrosyl, NOH, radical and air or oxygen (H_2O_2) into *o*-nitrosophenol has been reported upon by the writer in several papers (2-6). The very short-lived radical, NOH, is stabilized in the following paramagnetic copper complex $[Cu^I(NO)]$ (5). The unpaired electron is on the nitrogen atom. Using the so-called L solution (Cu metal + $NH_2OH \cdot HCl$ + air), one can easily demonstrate that even frozen solid benzene is converted into *o*-nitrosophenol or into its red copper salt (B reaction). New reactions with iron nitric oxide complexes are reported here, and the results help in understanding the conversion of benzene into *o*-nitrosophenol at 0° C.

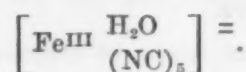
The best-known nitroso iron complexes are the nitroprussides. It has been known for a long time (7) that aqueous solutions of sodium nitroprusside become blue on standing in daylight, with the formation of Prussian blue compounds. The reaction is not very sensitive, and in weak daylight it may take hours before the solution becomes blue. Nitroprusside solutions were considered less light sensitive than ferrocyanide or pentacyano carbon monoxide solutions. The writer found, however, that nitroprusside solutions are just as light sensitive as ferrocyanide solutions. Even on winter days, nitric oxide, NO, is split off from the complex immediately (indicated by a positive Griess-reaction), but no color change takes place as in ferrocyanide solutions (pale yellow $\xrightarrow{\text{light}}$ intensive yellow). The writer found new color reactions with which one can demonstrate that nitroprusside solutions are decomposed even in daylight and at 0° temperature.

Dilute methyl alcoholic solution of nitroprusside, to which a very small amount of iron carbonyl, $Fe(CO)_5$, is added in the darkroom, gives a pale yellowish solution which, on standing, is unchanged in the dark but which changes color in a few seconds in daylight and becomes black in a few minutes—at the same time bubbles of CO are visible. The nitric oxide split off in daylight attaches itself immediately to the iron carbonyl complex, and black compounds are formed.

If a small amount of cupferron is dissolved in a dilute nitroprusside solution (darkroom), the pale yellowish-red solution remains entirely unchanged in the dark. If, however, it is exposed to daylight, a bluish tint appears in a few seconds, and usually in 1 min the solution is deep violet-blue. The violet-blue compound is



A mixture of nitroprusside, H_2O_2 , and sodium azide (NaN_3) made in the darkroom becomes pale blue in daylight in a few seconds and deep violet in a few minutes. The same mixture in the darkroom remains unchanged for hours. The violet compound is ferri-aquo salt



If thiourea is added to a nitroprusside solution in the darkroom, the solution retains its pale yellowish-red color for weeks and months. The mixture, however, becomes blue in the daylight in a few seconds, deep blue in a minute or so. If the nitroprusside solution without thiourea is exposed to light only for a few minutes, the illuminated solution which has not changed at all to the eye becomes immediately blue on adding thiourea. The light reaction with thiourea differs entirely in its mechanism from the other three reactions just described, in which NO is split off in the course of the reaction. In the thiourea reaction NO remains in the complex and the thiourea molecule attaches itself to the NO, thus forming a deep blue sulfur and nitrogen-containing complex. Since the color change does not take place in the dark at all, light must have changed NO in the original nitroprusside and made it reactive. This assumption is supported by an interesting light reaction, namely, the conversion of benzene into *o*-nitrosophenol in daylight at low temperature by short exposure of an H_2O_2 -containing nitroprusside solution covered with benzene.

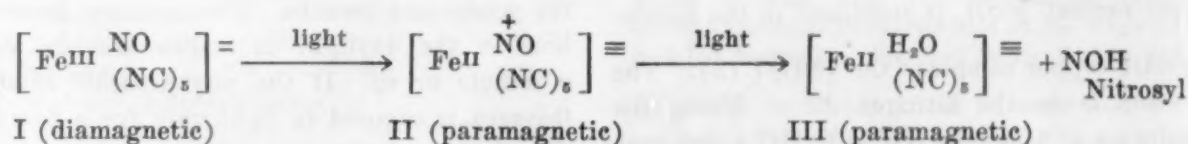
All solutions for this experiment were made in the darkroom. Five gm of sodium nitroprusside was dissolved in 100 cc of water and 2 cc of Perhydrol added. The ruby-red solution was put in an Erlenmeyer flask with ground-glass stopper and covered with 50 cc of benzene. The well-shaken mixture remains entirely unchanged in the dark for weeks or months. If, however, the Erlenmeyer flask is exposed to winter sunlight (outside air temperature was -15° C) for 5-10 min, the benzene becomes a beautiful green color. The aqueous part remains unchanged in color. The green benzene

pure *o*-nitrosophenol. On shaking with dilute CuSO_4 solution, the aqueous layer becomes deep red, while the benzene becomes entirely colorless. From the red Cu salt of *o*-nitrosophenol all the other metal salts can be layer was separated, washed well with water, and dried with anhydrous Na_2SO_4 . The green benzene contains easily prepared (5).

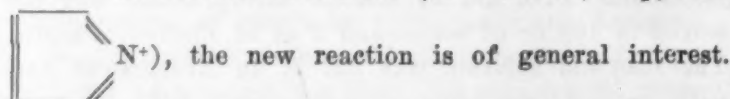
The photochemical synthesized *o*-nitrosophenol in benzene solution is unstable, and longer exposure discolors the green benzene to yellow or brown. Instead of using pure benzene, a mixture of ligroin and benzene can be used. The conversion of benzene into *o*-nitrosophenol in such heterogeneous systems as benzene (or benzene and ligroin) with aqueous phases at low temperature is unexpected.

The reason that nitroprusside (I) is diamagnetic is explained by the Welo and Baudisch rule (8). If, however, nitroprusside is exposed to light, the central ferric iron atom is reduced to the divalent form, and a paramagnetic nitroprusside (II) with the Effective Atomic Number 37 is formed. The unpaired electron is attached to the nitrogen of the $-\text{NO}$ grouping, which becomes extremely reactive. In this transitory condition it reacts with the sulfur atom in thiourea or with carbon in ethylene linkages.

The light reaction might be expressed schematically in the following manner:



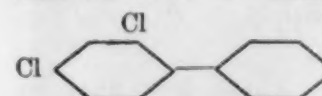
In the paramagnetic nitroprusside (II) the NO is very loosely linked to divalent iron (3). The nitrosyl, NOH, radical formed from hydroxylamine by oxidation attaches itself easily to ferro-aquo salt III (amminsalt in acid solution), forming a transitory paramagnetic nitroprusside compound (II) which contains the unpaired electron on the nitrogen just as in the B reaction, where NO is attached to monovalent copper ($\text{CuI}-\text{NO}$). It is for the octahedral arrangement in the iron complexes that NO (or O_2) attaches itself easily to the metal central atom. The nature of the bond type is of extreme importance and determines the reactivity of the nitrogen atom. Since any nitrogen atom under circumstances can become tetravalent (for instance, in pyrrole



These complexes may be transitory, lasting just long enough to permit an interaction with the substrate.

In the reactions just described between copper and iron nitroso complex compounds and benzene, the paramagnetic nitrogen atom enters the benzene ring and a new N-containing compound is formed.

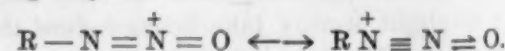
Other low-temperature reactions with benzene are known in which radicals are formed which unite with the nitrogen goes off as nitrogen gas (1). In these experiments 2,4,6-trichloraniline was used instead of aniline, treating pure trichloraniline diazonium nitrate with dilute NaOH at -25°C . The brilliant yellow diazo oxide or diazo anhydride formed is somewhat less explosive than the aniline compound. It decomposes very rapidly, however. After the violent reaction with benzene at -20° is finished from the reaction mixture

 was isolated. One chlorine atom was split off during the reaction and could be detected as HCl. Both diazo oxides mentioned here were much too unstable and explosive to permit magnetic measurements. The writer found that diazotized *p*-anizidine gives a diazo oxide which is much less explosive and could be used for measurements.

Diazotized *p*-anizidine is dissolved in NaCl containing ice water and treated slowly with 20% ice-cold NaOH solution. A brilliant orange-colored crystalline precipitate is formed which can be filtered and washed with ice water. As long as the crystals are wet they are not explosive. If dried on an ice-cold porous plate, the remaining yellow powder must be handled with utmost care. If scratched with the platinum spatula, it explodes. With benzene a violent reaction takes place with

the formation of nitrogen. The crystals are paramagnetic.

If we try to correlate these reactions with compounds extremely reactive to benzene, we find that all three contain paramagnetic nitrogen $[\text{Cu} = \text{N}^+ = \text{O}]$, $[\text{Fe} = \text{N}^+ = \text{O}]$, $[\text{N} = \text{N}^+ = \text{O}]$. In view of these new observations, the formula of diazo oxides may be written schematically in the following way:



The resemblance of the compounds to tetravalent nitrogen is obvious, but further experimental material is necessary to support the hypothesis.

References

1. BAMBERGER, E. *Ber. dtach. chem. Ges.*, 1896, 29, 446.
2. BAUDISCH, O. *Science*, 1940, 92, 336.
3. BAUDISCH, O. *J. Amer. chem. Soc.*, 1941, 63, 672.
4. BAUDISCH, O. *Amer. Sci.*, 1943, 31, 211.
5. BAUDISCH, O. *Arch. Biochem.*, 1944, 5, 401.
6. CRONHEIM, G. *J. org. Chem.*, 1947, 12, 1.
7. ROUSSIN. *Fortachr. Phys.*, 1852, 341.
8. WELO, L. A., and BAUDISCH, O. *Nature, Lond.*, 1928, 116, 606.

Simple Ink Writer for the Mercury Manometer

L. H. ANDERSON

Department of Pharmacology,
Northwestern University Medical School, Chicago

Methods have been described for recording, in ink, acid and femoral blood pressures in experimental animals, employing the mercury manometer (1, 2). These methods involve rather complex apparatus.

The ink writer illustrated (Fig. 1) is approximately 20 cm in height. The writing point is 27-gage tubing, rounded on the end and inserted into the lumen of the 22-gage tubing. The float, a solid Bakelite cylinder 6 mm in diameter, fits the bore of the glass manometer, the cap of which is shown at F. Bends in the tubing (C and D) permit the writing point to be slightly above the level of ink in the reservoir, so that the ink is transferred to the kymograph paper by capillary action.

A small 'V' guide, clamped to the manometer support, eliminates lateral motion in the writing point due to vibration. The 'V' so rests against the tubing that it holds the writing point against the kymograph paper and at the same time allows unrestricted vertical excursions.

Prior to use, the writer is filled with ink from a hypodermic syringe by fitting a 27-gage needle hub, from which the shaft has been removed, over the end of the writing point.

Ink writers for signal magnets are constructed from 22-gage hypodermic needles, bent so that the hub serves as the ink reservoir. The needle hub is held by a spring clip soldered to the spring bar of the signal magnet.

References

1. FEITELBERG, S. *Proc. Soc. exp. Biol. Med.*, 1942, **49**, 177.
2. QUIGLEY, J. P. *J. lab. clin. Med.*, 1934, **19**, 1342.

The Demonstration of P³² in Bone by Radioautography

ROBERT S. SIFFERT¹

Orthopedic Surgery and Physics Departments,
Mount Sinai Hospital, New York City

The study of phosphorus metabolism in bone by radioautography, using P³², has been limited by the technical difficulty involved in obtaining undistorted thin sections of undecalcified bone. Axelrod (1), who noted the removal and shifting of radioactive material during the process of decalcification, resulting in unsatisfactory or inaccurate autographs, developed a technique to cut 6- to 10-μ sections of celloidin-embedded undecalcified rat bones. The writer, using her technique, obtained satisfactory autographs in rats, but the histological detail of the stained sections was quite distorted. When the method was tried in rabbits, the bone proved to be too hard to cut with the microtome-blade technique.

A method was sought, therefore, to prepare bones of larger animals, containing radioactive phosphorus, for radioautographic studies. The possibility was investigated of using relatively large amounts of radioactive material as a tracer dose and partly decalcifying bone to the extent that thin, undistorted sections could be obtained, both for radioautographic and histological study. Using the inorganic acids usually employed in the decal-

¹ The author expresses his gratitude to Dr. Sergei Feltelberg, director, Department of Physics, for his invaluable suggestions and discussions and to Dr. Robert K. Lippmann, director, Orthopedic Surgery, under whose auspices this work was undertaken.

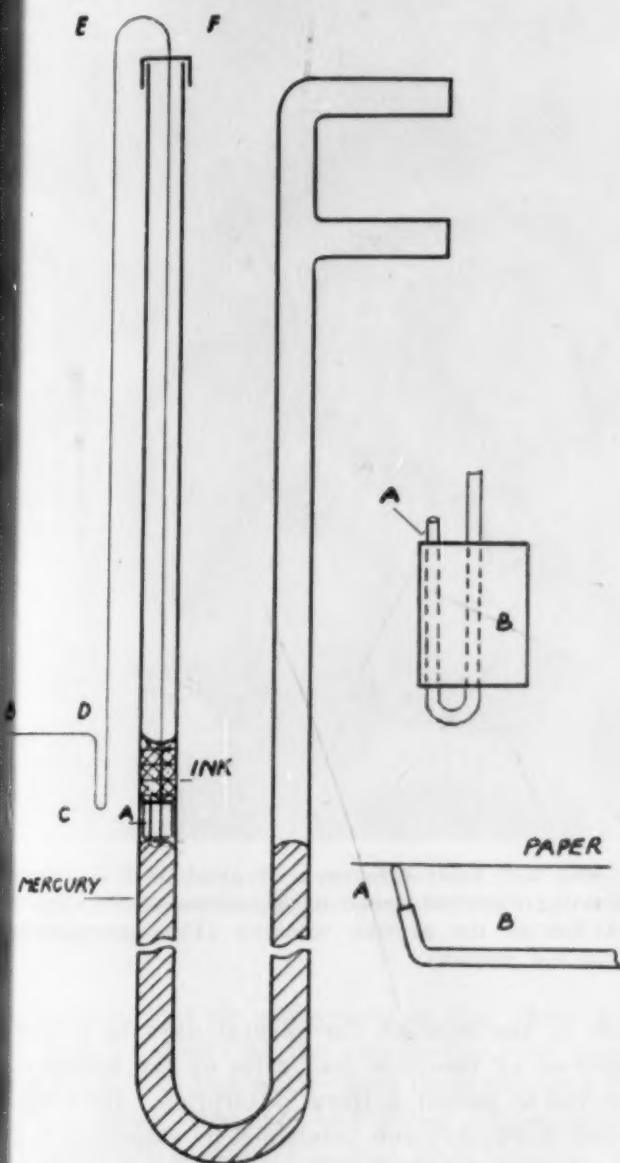


FIG. 1. Mercury manometer with ink writer in operating position. Illustrations at right show (top) detail of attachment of tubing to float (A, open end of tubing; B, solid Bakelite float) and (bottom) writing point viewed from above (A, 27-gage, and B, 22-gage stainless-steel tubing).

The ink writer now in use in this laboratory consists of a length of 22-gage stainless-steel tubing,¹ one end of which is attached to a float (A) and dips into a reservoir of ink floating on the mercury. The other end of the tubing serves as the writing point (B). Ink is drawn to the writing point by siphonage.

¹ Obtained from Becton, Dickinson and Co., Rutherford, New Jersey.

cification of bone (nitric and hydrochloric), it was noted that by the time bone was soft enough for easy cutting, most of the radioactive material had been removed. With formic acid, however, rapid bone softening was obtained (2 hrs in 2- to 3-kg growing rabbits using 30% formic acid), and relatively much larger amounts of radioactive element could be demonstrated in the bone.

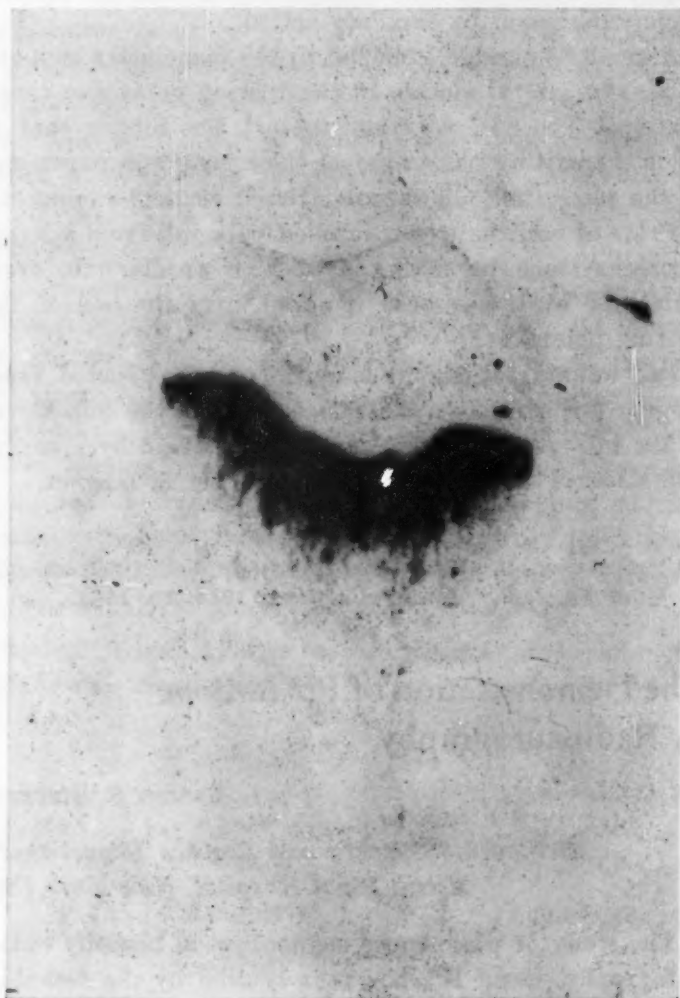


FIG. 1. Radioautograph of lower end of radius of growing rabbit demonstrating how P^{32} is metabolized in the epiphysis, epiphyseal line, and metaphysis (10x magnification; from 8- μ section).

The principle of binding phosphates at the site of liberation from organic compounds was introduced by Gomori (3) in the demonstration of acid and alkaline phosphatase. In the former reaction, inorganic phosphates are liberated from organic sodium glycerophosphate substrate by the action of the enzyme phosphatase in the tissue sections in an acid medium. The liberated inorganic phosphate is then immediately precipitated in the tissues at the site of enzyme activity by lead ions in solution, in the formation of insoluble lead phosphate. Although the softening of bone with acids is a far more complex reaction than the breakdown of glycerophosphates, this concept was applied to the decalcification process. It was felt that the presence of lead ions might bind phosphates as insoluble salts at their site of liberation from the complex bone apatite molecule during decalcification. By this means, larger quantities of P^{32} might be retained in bone that had been sufficiently softened so that thin sections could be easily cut in the

preparation of detailed histological sections and radioautographs.²

Growing rabbits of 1.0 to 2.5 kg were given intravenously 0.5 and 1.2 mc of P^{32} , respectively, and killed the following day. The bone was fixed in formalin, which a small amount of lead acetate (1-2%) had been added. It was found advisable to suspend the bone



FIG. 2. Radioautograph of epiphyseal line demonstrating excellent detail of deposition of P^{32} along the pattern of the growth columns (100x magnification; from 8- μ section).

gauze in the solution for several days to prevent the deposition of insoluble lead salts on the surface of the bone and to permit uniform adsorption. Bone was then washed thoroughly and decalcified by suspension in gauze in a solution of 30% formic acid until soft by the needle test (2 hrs). This could be hastened by decalcification in the incubator at 37° C. The specimen was then washed thoroughly, embedded in paraffin, and cut at the desired thickness. The sections (8-30 μ) were cut with ease with no nicking of the blade. Bone oversaturated with lead proved to be rather hard and crumbled on cutting. Experience was required to determine that point at which bone was soft enough for easy cutting, without permitting overdecalcification. Radioautographs were made after mounting the sections on slides and processing.

² Grateful acknowledgment is made to Dr. Boris G. Department of Pathology, for his suggestion that this principle of binding phosphates with metallic ions be applied to the present problem.

and radi... the dried sections, or sections coated with collodion, against a high-speed, no-screen, X-ray film (dental) in dark. Sections cut alternately with those used for autoradiography were mounted and stained directly for histological study. Excellent detailed radioautographs and histological sections were obtained and could be easily compared (Figs. 1-3).



FIG. 3. Photomicrograph of epiphyseal line demonstrating undistorted histological detail (200 \times magnification; 8- μ section).

quiring 2 weeks. In spite of this prolonged period, excellent detailed autographs were obtained only if the lead technique was used. It appears, therefore, that the lead-phosphorus compound formed is soluble in nitric and hydrochloric acids and insoluble in formic and acetic acids. The success of the method, then, probably depends upon the formation of metallic salts, with the liberated phosphate compounds during decalcification, that are insoluble in the solutions used for decalcification. The optimum pH is yet to be determined.

The possibility of transfer of radioactive material to nonradioactive areas during decalcification was considered. Comparative adsorption studies of P^{32} in solution into nonradioactive bone were performed by the use of autographs and the Geiger counter. It was noted that adsorption by bone was consistently much less from a 30% formic acid solution than from a water solution of P^{32} . The addition of lead to the solution before the bone was immersed resulted in the precipitation of an insoluble lead phosphate salt, permitting only relatively little adsorption of phosphorus into the suspended bone. From the beginning of decalcification through radioautography, pieces of rabbit bone containing no radioactive element were processed at the same time and in the same solutions as the pieces containing P^{32} and lead. Final radioautographs never demonstrated a shift of radioactive material to the control bone, regardless of whether the latter had or had not been presoaked in a lead acetate solution. It was felt that this, in addition to the fact that the autographs obtained showed the same distribution of P^{32} in 2.5-kg growing rabbit bones as did those prepared from undecalcified rat bones by the Axelrod technique, is further evidence that there is no material shift of the radioactive element. Geiger counter studies on the control specimens always revealed the adsorption of small amounts of phosphorus, but apparently the quantity of shift was so small compared to the quantity retained that it could not be demonstrated by autography. It may be that the presence of lead ions in solution causes the formation of an insoluble lead phosphate with those phosphate ions that are not locally bound on liberation, preventing readorption into nonradioactive areas.

Since much of the radioactive material is removed by this method of partial decalcification, even in the presence of lead ions, it is necessary to use relatively larger tracer doses. In order to be sure that material is not completely removed from critical areas under study, a preliminary profile is recommended. The type of profile will depend upon the character of any particular experiment and the detail required. Counts of calibrated areas before and after decalcification using a small hole in a lead shield, or a control autograph on an undecalcified section polished to 1- to 200- μ thickness (2), could be performed. Further investigation is indicated to determine whether, under optimum circumstances, sufficient amounts of radioactive element are removed to require control profiles.

In vivo studies performed by injecting 200 mg of lead acetate intramuscularly daily for 3 successive days into 2.5-kg growing rabbits, followed by the injection of

It was noted that the autographs at 8 μ , when viewed under the 100 \times power of the microscope, were slightly better in detail, with less scatter than those obtained from 30- μ sections. Detailed and gross radioautographs prepared by this method of partial decalcification, with and without the use of lead, revealed that although large amounts of P^{32} were removed, consistently much larger quantities were retained in those specimens in which lead was used. Further investigation is indicated to determine the nature of the lead-phosphorus combination. A careful control of chemical conditions, and perhaps the use of other metallic substances, might increase the amount of phosphorus bound as insoluble salt at the site of liberation.

When nitric or hydrochloric acids were used in place of formic acid, the amount of phosphorus retained after partial decalcification using lead was not greater than those specimens where lead was not used. When acetic acid was used, decalcification was very slow, often re-

0.5 mc of P^{32} , were performed. Bone was partially decalcified with formic and nitric acids. Those sections decalcified with formic acid gave satisfactory autographs and demonstrated the retention of lead when dipped into a dilute solution of yellow ammonium sulfide. Those decalcified with nitric acid retained neither P^{32} nor lead.

Preliminary observations on adult giant rabbit and dog bones, softened overnight in formic acid, indicate that, since the metabolic turnover of phosphorus is slower than in growing animals, much larger tracer doses and longer intervals between injection and sacrifice of the animals are required. Further investigation is required to determine whether the method is applicable to adult rabbits and dogs.

References

1. AXELROD, D. J. *Anat. Rec.*, 1947, **98**, 19.
2. BARTELSTONE, H. J., MANDEL, I. D., OSHRY, E., and SEIDLIN, S. M. *Science*, 1947, **106**, 130.
3. GOMORI, G. *Arch. Path.*, 1941, **32**, 189.

Lipemic Nephrosis in Rats¹

WALTER HEYMANN and HERBERT Z. LUND

*Departments of Pediatrics and Pathology,
Western Reserve University School of Medicine,
Cleveland, Ohio*

The experimental production of chronic renal disease by means of heteronephrotoxins was first reported by Lindemann (3). Masugi produced the disease in rabbits and described it as chronic glomerulonephritis (4). Smadel, Swift, and Farr (7) studied nephritis in rats induced by intravenous injection of antikidney serum obtained from rabbits and described it as a diffuse chronic and progressive glomerulonephritis. Smadel and Swift (5, 6), using rats of the Whelan, Evans, and Wistar strains, observed decreasing susceptibility to nephrotoxin and increasing capacity to recover from the initial nephrotoxic injury, in that order. Progressive glomerular disease was more severe in the Whelan than in the Evans and Wistar rats, and a high protein diet aggravated the course in the former and not in the latter strains (7).

We used the technic described by Smadel, Swift, and Farr with the following differences: (a) We used a Waring blender for the preparation of kidney extracts; (b) we kept extracts and sera frozen for indefinite periods; (c) after addition of 1,000 units of penicillin/cc, some of our extracts were kept under toluene for 24 hrs at 37° C in an incubator; (d) the amount of serum given was not based on body weight but was calculated according to kidney weight; (e) we used rats of the Long-Evans strain exclusively; and (f) some rabbits were injected intramuscularly with extracts incorporated into an emulsion containing paraffin oil, a lanolin-like substance, and dry heat-killed tubercle bacilli (1).

¹ Aided by grants from the Life Insurance Medical Research Fund, the John and Mary R. Markle Foundation, and the Louis D. Beaumont Trust.

Sixteen rabbits were repeatedly injected intraperitoneally and 3 intramuscularly with renal extracts obtained from rats. The intraperitoneal treatment has thus been more efficacious in producing nephrotoxic sera than has the intramuscular injection of extracts incorporated in Freund's adjuvants.

Six rabbits were treated with renal cortex, 7 with medulla, and 6 with extracts obtained from undissected kidneys. The separation of cortex and medulla was proximate and was done by sharp dissection. All of the sera obtained from rabbits treated with cortex and kidney extracts produced chronic renal disease in rats. Among the 6 sera obtained from rabbits treated with renal medulla, only 1 was about equally nephrotoxic to cortex. The other 5 produced a mild, transient proteinuria, and 3 were inactive. The ability of medulla extracts to produce nephrotoxic sera was not enhanced by injecting rabbits with a mixture of 2 parts of a 20% medulla suspension with 1 part of a 20% rat spleen suspension.

Renal disease produced by intravenous injection of various nephrotoxic sera was obtained in 103 rats. The production of disease depended on dosage and on individual susceptibility of the rats. Massive proteinuria was observed 1-2 days after intravenous injection of nephrotoxic serum. When boiled with acetic acid, the urine often coagulated. Gross hematuria was not observed, and microscopic erythrocyturia was rare. A few leucocytes and numerous casts were usually present. Within the first and second week marked ascites and edema developed in 33 animals and persisted usually 1-3 weeks. The natural course of the disease was observed in 35 rats. Spontaneous cures were observed in 13, a succession of remissions and relapses was seen in 12, and 10 rats showed a continuous, uninterrupted proteinuria for as long as 11 months. Blood pressure readings obtained in 42 unheated, nonanesthetized animals (2) varied between 90 and 125 mm Hg.² Forty animals remained normotensive during the course of their illness. In 2 rats hypertensive episodes with systolic values ranging between 130 and 145 mm Hg were observed 3½ and 4 months, respectively, after onset of their disease.

Severe hypoproteinemia (lowest value, 1.6 gm/100 cc) and marked hyperlipemia (highest values, 1.96 gm/100 cc cholesterol and 19.5 gm/100 total lipids) were regularly observed in severely sick animals. In late stages of the disease a moderate degree of azotemia was observed once. However, high nonprotein nitrogen values (100-200 mg/100 cc) were frequently obtained when rats were injected with lethal doses of markedly nephrotoxic sera. The blood pressure in all these animals was normal, and the highest concentration of creatinine observed in the blood was 2.6 mg%. High (40%) or low (5%) protein diets, otherwise isocaloric, were without influence on course or severity of the disease.

Histological examinations of kidneys and other tissues were obtained in 83 rats. The conspicuous renal changes

² An apparatus was obtained from the Lederle Laboratories Division, American Cyanamid Company, through the courtesy of the late Y. Subbarow.

the presence of much protein in the nephrons. It was most abundant and deeply stained in the distal convoluted and collecting tubules but was also present in the proximal convoluted tubules and subcapsular spaces of the glomeruli. The cells of the proximal convoluted tubules were usually swollen and granular and often showed hyaline droplet degeneration. The cells of the distal convoluted tubules showed similar but less striking changes. Special stains demonstrated fatty degeneration, notably in the convoluted tubules, and lipemia was noted in many cases. Slight degrees of chronic and subacute interstitial inflammation were present in 5 cases. There were no glomerular lesions except in 3 cases. These rats were killed, or died, 4, 5, and 8 days after onset. The capillaries were dilated with blood and with a hyaline exudate. The tufts were comparatively acellular. Basement membranes were irregularly thickened in places but normal and even attenuated in others. In one instance a few neutrophilic polymorphonuclear leucocytes were present in the tufts and in the proximal convoluted tubules.

References

- FREUND, J., and McDERMOTT, K. *Proc. Soc. exp. Biol. Med.*, 1942, **49**, 548.
 KERSTEN, H., BROSENE, W. C., ABLONDI, P., and SUBBAROW, Y. *J. lab. clin. Med.*, 1947, **32**, 1090.
 LINDEMANN, W. *Ann. Inst. Pasteur*, 1900, **14**, 49.
 MASUGI, M. *Beitr. path. Anat. U.Z. Allg. Path.*, 1933, **91**, 82; 1933, **92**, 429.
 SMADEL, J. E., and SWIFT, H. F. *J. clin. Invest.*, 1939, **18**, 757.
 SMADEL, J. E., and SWIFT, H. F. *J. exp. Med.*, 1941, **74**, 345.
 SMADEL, J. E., SWIFT, H. F., and FARR, L. E. *J. exp. Med.*, 1936, **64**, 921; 1937, **65**, 527; 1939, **70**, 615.

Effect of Galactose on the Utilization of Fat¹

CURT P. RICHTER

*Psychobiological Laboratory,
 Johns Hopkins Medical School, Baltimore*

Schantz, Elvehjem, and Hart (10) reported that fat plays an important part in the utilization of galactose. They offered as evidence the observations that rats kept on a diet consisting only of skim milk excreted large amounts of galactose, and that the addition of butter fat (roughly in an amount equal to that of the lactose in the skim milk) reduced the excretion of galactose. Geyer, Outwell, Elvehjem, and Hart (7) offered further similar evidence to prove this point.

With an entirely different technique, evidence was obtained in this laboratory that a reverse relationship exists between fat and galactose, namely, that galactose plays an important part in the utilization of fat.

For these experiments the so-called "single-food-choice technique" was used. Previous papers give full details

¹This study was carried out under a grant from the Sugar Research Foundation, New York City.

(8, 9). It will suffice here to state that in the simplest form of this method rats of a standard weight and under standard conditions are placed on a diet that consists of only one foodstuff and water. The length of time the rats survive is taken as a measure of the nutritive value of the foodstuff. For example, it was found that without any food rats survived, on the average, only 4 days, whereas on galactose they survived 6 days and on glucose, 37 days. The significance of the results obtained with this technique depends on the observation that under these conditions rats seem to eat just as much of a purified foodstuff as they are able to utilize. This method has also been used, in a slightly more complicated form, to study the effects produced by various supporting substances. It was used, for example, to study the effect of thiamine on the utilization of glucose. To do this, the rats on a diet consisting exclusively of glucose were offered as a supplement 0.02% solution of thiamine hydrochloride. These rats survived, on the average, 76 days, or twice as long as on glucose alone, thus demonstrating beyond any doubt the remarkable effect that thiamine has on the utilization of glucose. In another form of this technique the interaction of foodstuffs on their mutual utilization can be studied by offering two foodstuffs at one time, as was done in the present experiments.

For these experiments domestic Norway rats were kept separately in cages that contained one or two nonspillable food cups and a graduated inverted bottle for water. The cages were made of wire cloth and were equipped with a large-meshed, wire-screen bottom to eliminate coprophagy.

Rats were started in the cages at ages of 38-47 days and kept on the stock diet until they were changed to the single-food diet. This occurred when they reached weights of between 120 and 150 gm.

In one series the rats had access only to galactose; in a second, only to oleo²; and in a third, to oleo and galactose (in separate containers). In a control series the rats had no food at all. On no food at all 15 rats survived from 3 to 6 days, with an average of 4.3 days. On galactose alone 13 rats survived from 4 to 8 days, with an average of 6.2 days; on oleo 10 rats survived from 19 to 38 days, with an average of 32.4 days; and on oleo and galactose 13 rats survived from 47 to 92 days, with an average of 69.3 days. This was over twice as long as on oleo alone, and over 11 times as long as on galactose alone.

Clearly, either the oleo must have had a great effect on the utilization of the galactose or the galactose must have had a great effect on the utilization of the oleo.

A comparison of the amounts of oleo and galactose eaten by the rats when they had simultaneous access to these two foodstuffs throws light on this relationship. The total caloric intake (average for the first 40 days) was 261.2 cal/kg/day, with the galactose contributing an average of 39.9 cal/kg, or only 15.3% of the total. For some of the rats the average daily galactose intake

²Mrs. Filbert's, Baltimore, Maryland—vegetable oil, 80%; moisture, 15%; salt, 3.1%; skim milk, 1.5%; derivative of glycerine, 0.2%; sodium benzoate, 0.1%; vitamins from fish livers, 0.1%.

fell below 5% of the total. One rat that survived 71 days ate galactose only at irregular intervals and then in small amounts, while it ate constantly large amounts of oleo; at one stage it ate no galactose for 15 days. These results indicate that the calories received from galactose could not have contributed substantially to the length of time that the rats survived.

Of special interest is the fact that the rats with access to galactose ate more oleo than did those having access only to oleo, and much less galactose than did the rats that had access only to galactose.

The role played by galactose in relation to fat may be similar to that played in single-food-choice experiments by thiamine in relation to glucose (8); both increased amounts of the respective foodstuffs that the rats were able to utilize and thus increased the survival times.

In further experiments it was found that the ingestion of a mixture of oleo and galactose (9 or 19 parts of oleo to 1 part of galactose) had a similar effect on the survival time. In contrast, the ingestion of a mixture of oleo and glucose in the same proportions failed to increase the survival times above those of rats on oleo alone. This result indicates that galactose may have a specific effect on the utilization of fat.

In the reverse experiment a small amount of oleo was added to galactose (1 part to 9 parts of galactose). On this mixture the rats did not live significantly longer than they did on galactose alone.

These self-selection experiments in which the rats had access to galactose and oleo brought out a relationship between these substances which, on the basis of present biochemical knowledge, might not have been suspected. With their selections the rats showed that only very small amounts of galactose suffice to bring about a great increase in the utilization of the fat, oleo, and that large amounts are detrimental. Ershoff (5) produced cataracts on single-food mixtures of dextrose and galactose (50:50) and on butter fat and galactose (30:70); and Ershoff and Deuel (6) failed to find this marked effect of galactose on the utilization of fat, apparently because of the high proportion of the galactose in the single-food mixtures of galactose and oleo (70:30).

These experiments with oleo were started during the war, when butter was not available in adequate amounts. Butter would have been a better fat with which to start; still better would have been a fat that does not contain even the very small amounts of protein, milk solids, and vitamins that are present in oleo.

Preliminary experiments with corn oil and galactose have thus far given essentially the same results.

The results show that fat apparently does not have any effect on the utilization of galactose. They do not agree with the conclusions of Schantz, *et al.* (10), but do agree with those of Zialcita and Mitchell (11). The latter workers repeated the experiments of Schantz, *et al.*, but with a purified diet rather than with skim milk powder, and found that the addition of fat did not alter the excretion of galactose. They concluded that fat, as such, has no influence on the metabolism of galactose.

In single-food-choice experiments in which fat con-

stitutes the entire diet it is possible that ketosis prevents the rats from living longer. The observations of Deuel and Chambers (3), of Deuel, Gulick, and Butts (4), of Butts (1) and Clark and Murlin (2) have shown that galactose has a strong antiketogenic effect, stronger than that of either glucose or fructose. This antiketogenic action might help to increase the survival time.

Deuel, Gulick and Butts (4) have reported that the ingestion of galactose has a pronounced nitrogen-sparing action. This action may also have helped to increase the survival times of the rats in the present experiments.

In the absence of more definite biochemical data, however, it would seem likely that these results depend on some specific and unknown metabolic effect of galactose.

Should the results of further experiments on rats be close that galactose in such small amounts has the same effect on other fats as it does on oleo, and that galactose has a superior action to all other sugars in this respect, the fortification of common fats and oils with small amounts of lactose, galactose, or skim milk powder might be considered for the diet of man.

References

1. BUTTS, J. S. *J. biol. Chem.*, 1934, 105, 87.
2. CLARK, D. E., and MURLIN, J. R. *J. Nutrition*, 1936, 12, 469.
3. DEUEL, H. J., JR., and CHAMBERS, W. H. *J. biol. Chem.*, 1925, 65, 7.
4. DEUEL, H. J., JR., GULICK, M., and BUTTS, J. S. *J. biol. Chem.*, 1932, 98, 333.
5. ERSHOFF, B. H. *Amer. J. Physiol.*, 1946, 147, 13.
6. ERSHOFF, B. H., and DEUEL, H. J., JR. *Amer. J. Physiol.*, 1947, 148, 45.
7. GEYER, R. P., BOUTWELL, R. K., ELVEHJEM, C. A., and HART, E. B. *J. biol. Chem.*, 1946, 162, 251.
8. RICHTER, C. P., and RICE, K. K. *Amer. J. Physiol.*, 1942, 137, 573.
9. RICHTER, C. P., and RICE, K. K. *Amer. J. Physiol.*, 1945, 143, 336.
10. SCHANTZ, E. J., ELVEHJEM, C. A., and HART, E. B. *J. biol. Chem.*, 1938, 122, 381.
11. ZIALCITA, L. P., JR., and MITCHELL, H. H. *J. Nutrition*, 1945, 30, 147.

A Qualitative Chemical Change in Carcinogenesis¹

CHRISTOPHER CARRUTHERS and V. SUNTER
Barnard Free Skin and Cancer Hospital and
Department of Anatomy, Washington University
School of Medicine, St. Louis

In a review article on the "Properties of Cancer Cells" by Cowdry (3) the statement by Voegtlin is reiterated in that "no conclusive evidence exists at present which reveals any qualitative differences in chemical composition between normal and malignant cells. Whatever differences do exist are of a quantitative nature, the biological significance of which is difficult to evaluate."

In this paper evidence is presented to show that an alteration in the nature of a lipid, probably associated

¹ This investigation was aided by grants from the National Cancer Institute, the Charles F. Kettering Foundation, and the American Cancer Society.

a protein, occurs in the process of epidermal carcinoma in mice. The procedures for shaving the mice, applying the carcinogen, methylcholanthrene, and removing the epidermis from dermis have been described (2). The epidermis or other tissues were extracted by refluxing on a steam bath with mixtures of peroxide-free ether and alcohol prepared by shaking occasionally with powdered calcium oxide for a period of 1-2 days and then filtering from a small fractionating column. After the tissues were extracted twice for a period of $\frac{1}{2}$ hr, the solutions were filtered into 150-ml beakers and evaporated to near dryness on a steam bath. The last traces of solvent were removed *in vacuo* in a desiccator over CaCl_2 . The total lipid was then re-extracted with anhydrous peroxide-free ether, and the latter filtered through Munk-

R_4NI) was used as a supporting electrolyte. Dioxane was purified and R_4NI prepared by the procedure of Laitinen² and Wauzonek (5). Dioxane was added to the lipid in the Erlenmeyer flask, and the solution was completed by warming on a steam bath. Redistilled water was then added to attain the desired concentration and sufficient R_4NI to make a final concentration of 0.1 M, the latter concentration being used in all the experiments. The mixture was then warmed on a steam bath to facilitate solution. The electrolysis with a Sargent, Model XXI, Polarograph was carried out with a mercury pool anode in an Heyrovsky vessel of suitable size which was provided with side arms for anode connection, introduction of nitrogen, removal of oxygen, and admittance of a slow stream of nitrogen over the solution during electrolysis. The nitrogen was passed through dioxane prior to its entrance into the vessel. All measurements were made at 25° C. The anode potential was measured against a saturated calomel electrode (S.C.E.) with a salt bridge in the usual manner (4).

A polarogram of the lipid of methylcholanthrene-treated mouse epidermis extracted with a mixture containing 50% alcohol and 50% ether is shown in Fig. 1.

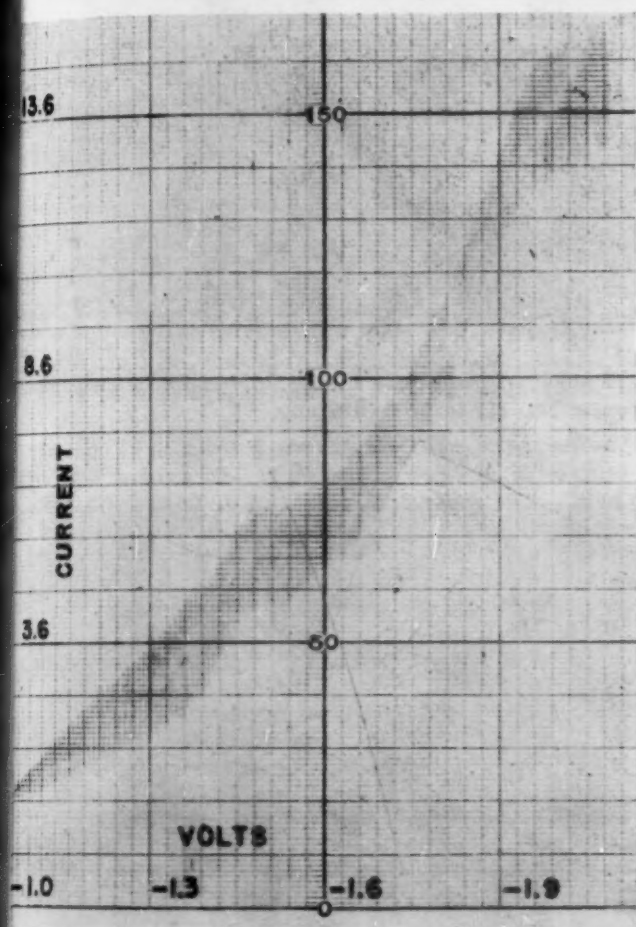


FIG. 1. Polarogram of the lipids from hyperplastic mouse epidermis in 75% dioxane.

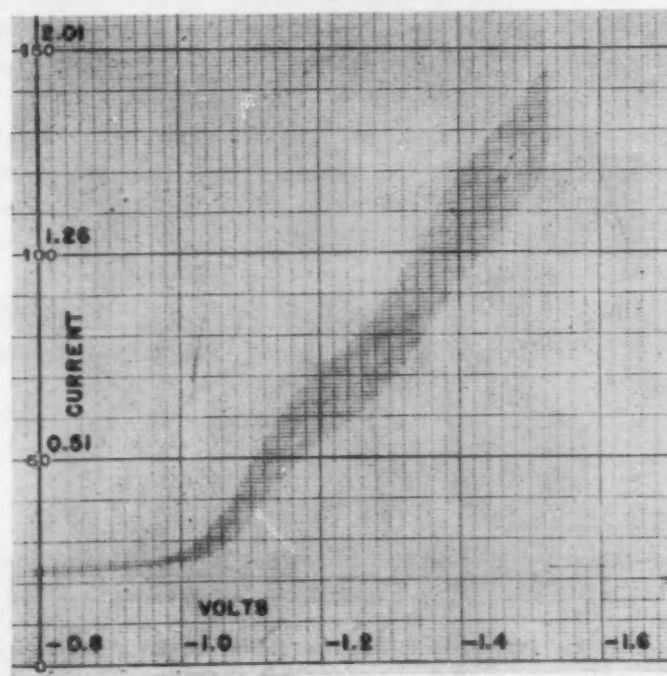


FIG. 2. Polarogram of the lipids from hyperplastic mouse epidermis in 50% dioxane.

all's OB paper into a weighed, glass-stoppered, 50-ml Erlenmeyer flask. The ether was then driven off on a steam bath, the last traces being removed with a stream of nitrogen, and the samples were stored in an atmosphere of nitrogen in a refrigerator until ready for use. Since the polarograph was found to be very useful for the quantitative determination of cytochrome C and for following the purification of the latter from tissues (1), the possibility of using this instrument for a study of the electrolysis of the lipids extracted from mouse tissues was investigated. After tests with various organic solvents it was found that mixtures of dioxane and water were most suitable for the polarography of lipid substances. Tetra-*n*-butylammonium iodide (hereafter denoted by

In all the figures the current is expressed as microamperes against the applied potential in volts. The half-wave potential of the first wave is -1.76 v and that of the second, -2.10 v vs. the S.C.E. The concentration of the lipid was 9.8 mg/ml; of water, 25%; and of dioxane, 75% (anode potential, -0.430 v). Two distinct waves were present, and for further resolution the water concentration was increased to "water out" the more insoluble lipids. This effect is demonstrated in Fig. 2.

² The authors are indebted to H. A. Laitinen for samples of pure and crude tetra-*n*-butylammonium iodide used in the preliminary phase of this work. A good grade of this quaternary ammonium salt can be obtained from the Rhoads Chemical Company, 417 Cleveland Avenue, Plainfield, New Jersey.

The lipid concentration was 6.5 mg/ml and that of dioxane, 50% (anode potential, -0.390 v). The nature of the lipids in solution is so altered that a double wave has now appeared where the first wave appeared in Fig. 1. The half-wave potential of the first wave is -1.47 v and that of the second, -1.66 v vs. the S.C.E. The third wave, corresponding to the second wave of Fig. 1, is not shown since it was not altered appreciably during carcinogenesis. Even when the lipid concentration is reduced to 3.25 mg/ml and that of the dioxane to 37.5%, the double wave, the same as that in Fig. 2, is well defined. The half-wave potentials of the two waves are the same throughout carcinogenesis (Table 2).

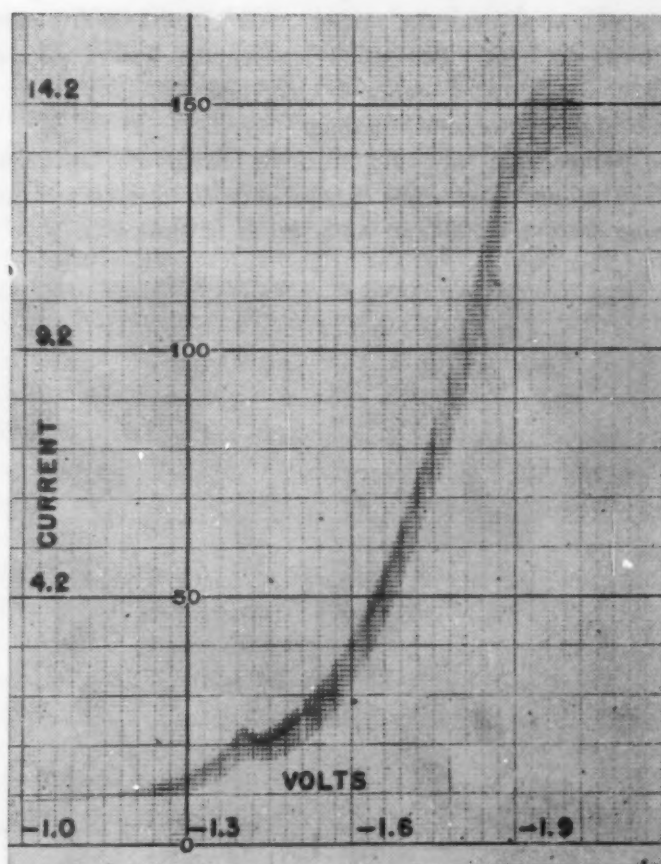


FIG. 3. Polarogram of the lipids from a methylcholanthrene-induced tumor in 75% dioxane.

When methylcholanthrene-induced carcinomas and transplantable carcinomas (Nos. I³, II³, and III³) were extracted with a mixture containing 50% alcohol and the lipid polarographed as above, a great difference was noted. A polarogram of the lipid from an induced tumor is shown in Fig. 3. The lipid content was 13 mg/ml in 75% dioxane. The half-wave potential of the first wave is -1.79 v, and of the second, -2.13 v vs. the S.C.E. When Fig. 3 is compared with Fig. 1, it can be seen that the first wave of the latter has a different curvature and appearance than that of Fig. 3.

When the lipid of this carcinoma sample was reduced

³ Transplantable tumors Nos. I and II are well-differentiated squamous cell carcinomas with many mitoses. The nuclei of tumor No. II are larger than those of No. I. Tumor No. III is very well differentiated, slow growing, and contains less mitosis than tumors I and II.

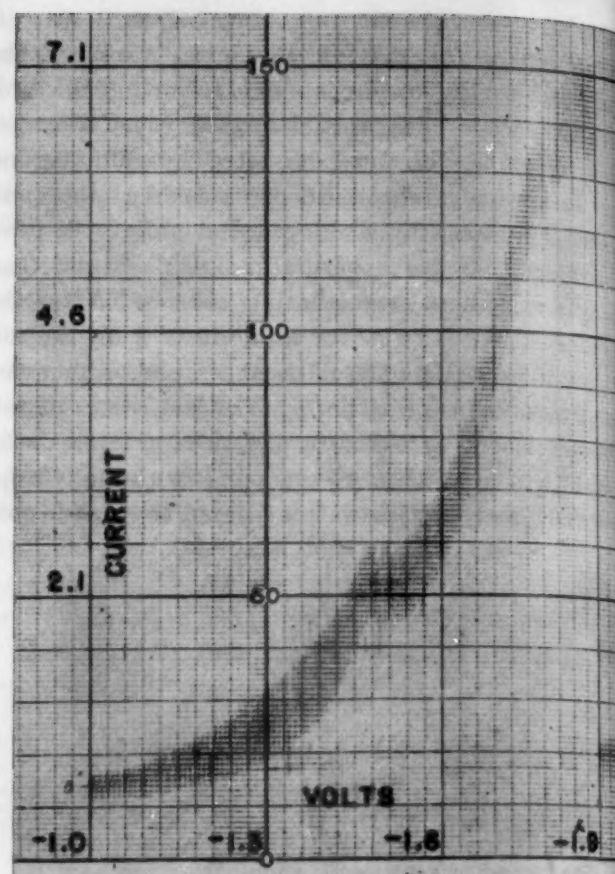


FIG. 4. Polarogram of the lipids from transplantable tumor No. III in 75% dioxane.

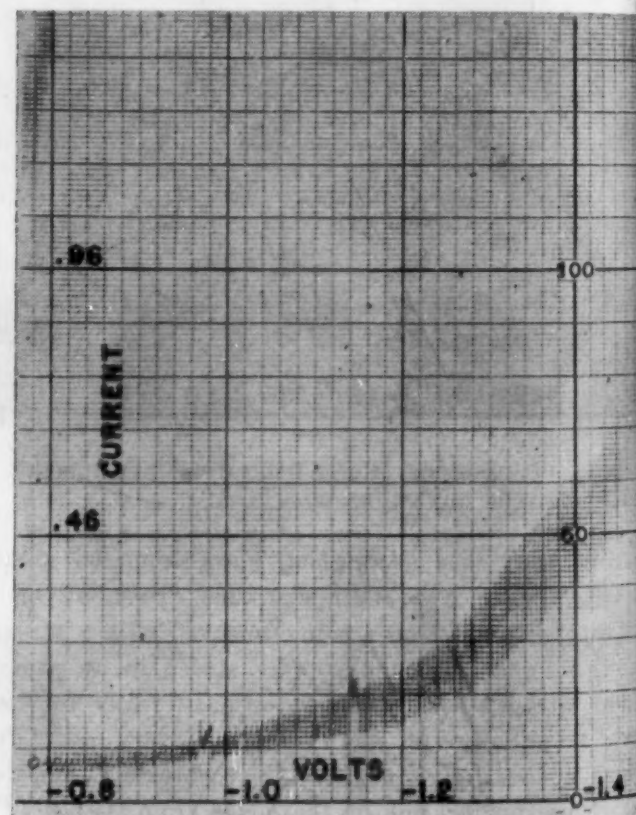


FIG. 5. Polarogram of the lipids from tumor No. III in 50% dioxane.

to 6.5 mg/ml in a mixture of 50% dioxane, no wave appeared comparable to the double wave of Fig. 2. However, some of the methylcholanthrene-induced tumors

ed in a 50% alcohol mixture did give a single wave
lar to that of Fig. 5. The reason for this lack of
istency with induced tumors will become apparent
On the other hand, transplantable tumors, with
exception of 2 of 5 samples of tumor No. II, did
give the single wave when extracted with a mixture
aining 50% alcohol.

TABLE 1
HALF-WAVE POTENTIALS OF THE REDUCIBLE MATERIAL
IN CARCINOMAS

Type of carcinoma	Percentage of alcohol in al- cohol-ether mixture	Half-wave poten- tial in volts vs. the S. C. E.
Induced	25	-1.62
	25	-1.72
	40	-1.72
Induced*	50	-1.65
Tumor No. I	25	-1.70
" "	25	-1.66
" "	75	No wave
Tumor No. I†	40	"
" "†	10	"
Tumor No. II	75	"
" "	50	-1.64
Tumor No. II‡	50	-1.64
Tumor No. III	25	-1.68
" "†	25	No wave

Average of 6 samples. About 50% of induced tumors
the wave.

Tumor in 95% alcohol overnight, then ether added.

Two of 5 tumors No. II gave the wave in a mixture of
ether, 50% alcohol, but none of tumors Nos. I and II.

mixture of 50% dioxane, there was a single wave with
half-wave potential of -1.68 v vs. the S.C.E. (Fig. 5).
The half-wave potentials for other tumor samples are
shown in Table 1.

An examination of Table 1 reveals that the half-wave
potential of the single wave found in the carcinomas is
nearly the same as that of the second wave of the double
wave (Fig. 2) found in normal and hyperplastic epi-
dermis (Table 2). In other words, the component re-
sponsible for the first wave of the lipid of normal and
hyperplastic epidermis has been altered and is no longer
reducible at the dropping mercury electrode. Therefore,
a qualitative chemical change in a lipid has occurred dur-
ing carcinogenesis, and experiments were devised to ascer-
tain whether the material in normal and hyperplastic
epidermis having the double wave consisted of a single
compound or of two compounds, one of which had been
altered in the carcinomas so that it was no longer
reducible.

When normal or hyperplastic epidermis is extracted
with mixtures containing 40, 50, 60, or 75% ether, the
double wave is obtained, and a nearly constant differ-
ence in voltage (average, 0.21 v) exists between the
second and first wave (Table 2). Furthermore, the half-
wave potential of the waves is independent of the con-
centration of the lipid (approximately 3-12 mg/ml) and
of the dioxane concentration between 62.5 and 37.5%.
These observations indicate that we are dealing with a
single compound. On the other hand, the single wave of
the carcinoma (Fig. 5) is always obtained in material
extracted by mixtures containing 60 and 75% ether. It

TABLE 2
HALF-WAVE POTENTIALS OF THE REDUCIBLE MATERIAL IN NORMAL AND HYPERPLASTIC EPIDERMIS

Epidermis	Percentage of alcohol in alcohol-ether mixture	Half-wave potentials in volts vs. S. C. E.					
		First wave			Second wave		
		A	B	C	A	B	C
Normal	50		-1.48	-1.48		-1.69	-1.65
	40		-1.49	-1.40		-1.74	-1.70
	25		-1.46	-1.49		-1.68	-1.65
	60		-1.48	-1.40		-1.73	-1.60
Hyperplastic paintings with MC*	60		-1.47			-1.66	
"	25	-1.46	-1.49	-1.42	-1.69	-1.68	-1.63
"	25	-1.48			-1.73		
"	50	-1.48	-1.47	-1.42	-1.69	-1.68	-1.65

A—in 62.5% dioxane at $\frac{1}{2}$ original concentration.

B—" 50.0% " " $\frac{1}{2}$ " "

C—" 37.5% " " $\frac{1}{2}$ " "

* Methylcholanthrene.

was found only occasionally in the induced, and never in
the transplantable tumors Nos. I and III if the alcohol
content of the extractant was 50% or more. The half-
wave potential of this single wave is nearly the same
as that of the second part of the double wave of epi-
dermis. If normal or hyperplastic epidermis is allowed
to stand in 95% alcohol for 1-10 days in a refrigerator

and then sufficient ether is added to make a 50% mixture, the material showing the double wave can be extracted. In contrast, if the carcinomas are treated in a similar fashion, the single wave shown by these tissues never appears, and even adjusting the ether concentrations in the extracting solution to 60 and 75%, after fixation in 95% alcohol, concentrations which are most effective in obtaining the wave from fresh tissue give only small amounts, if any, of this reducible material. Ethyl alcohol probably fixes the lipoprotein *in situ* and renders the lipid practically nonextractable under our conditions. It is thus apparent that the lipid in the carcinoma differs from that in the tissue of origin with respect to solubility in ether and to extractability from the tissue after fixation in 95% alcohol. The half-wave potentials of the double wave in the lipid of normal and hyperplastic epidermis are the same over a wide range of concentrations of alcohol and ether in the mixture used for extraction. The half-wave potentials are also independent, within the limits studied, of the amount of lipid, water, and dioxane in the solution which is polarographed, and the diffusion current of the double wave/100 mg of lipid is approximately constant under these conditions. In addition, the double wave is unaltered after fixation in 95% ethyl alcohol and subsequent extraction. These data indicate that the reducible material is probably a single com-

pound. In the carcinomas the solubility of the altered lipid is so changed as to require more ether for solution and, moreover, is fixed in large part *in situ* by the addition of alcohol and this becomes almost ether insoluble. The single wave has a half-wave potential almost the same as that of the second wave of the two found in epidermis.

The differences described above that were found in the behavior of the material from mouse epidermis and from the tumors at the dropping mercury electrode demonstrate that an alteration in the structure of a lipid occurs during the process of epidermal carcinogenesis in mice. The difference in the lipid of the carcinomas is due to a quantitative alteration of a part of the lipid material of normal and hyperplastic epidermis, but the net result is a qualitative change resulting in altered physical and chemical properties of the lipid material.

References

1. CARRUTHERS, C. *J. biol. Chem.*, 1947, **171**, 641.
2. CARRUTHERS, C., and SUNTZEFF, V. *Cancer Res.*, 1947, **7**, 9.
3. COWDRY, E. V. *Arch. Path.*, 1940, **30**, 1245.
4. KOLTHOFF, I. M., and LINGANE, J. J. *Polarography*. New York: Interscience, 1941.
5. LAITINEN, H. A., and WAUZONK, S. *J. Amer. chem. Soc.*, 1942, **64**, 1765.

Book Reviews

An outline of social psychology. Muzafer Sherif. (Ed. by Gardner Murphy.) New York: Harper, 1948. Pp. xv + 479. (Illustrated.) \$4.00.

The time was, and not very many years ago, when a certain text in social psychology contained little but the views of a single psychologist regarding a few of the phenomena of our social order. Another text of this period served as a vehicle in which the ideologies of Freud, Lewin, and Marx were made to appear somewhat compatible. In contrast, the texts of today are far more alike. They adopt rather similar eclectic positions regarding the theoretical structure of their science and are careful not to ignore its more important experimental data. Yet there still would appear to be uncertainty as to just what areas make up the field of social psychology.

And, of course, there is the well-known tendency for each textbook writer to ride his own hobby. Thus, the basic research interests of M. Sherif being what they are, it should come as no surprise that approximately 60% of the space of his *An outline of social psychology* should be allocated to "Groups and Norms (Values)." Another portion is devoted to "Motives" and the rest to "Individual Differences in Social Reactions."

Sherif's text is noteworthy for its judiciously chosen references to contemporary lay source materials, the writings of Ernie Pyle being featured most often. New-

comb has written a section on his important Bennington College researches. Also noteworthy are two chapters, "The Effects of Deprivation at the Human Level (Individual and Social)" and "The Effects of Technology." The latter is particularly interesting in that it presents a brief account of the worth-while work Sherif did many years ago with many villagers in the more remote parts of Turkey.

In the "Editor's Introduction" Gardner Murphy says of Sherif: "To him, more than to any other single person, is attributable the whole manner of approaching social psychology which characterizes the present period. Whether this is a valid statement or merely the outpourings of a too enthusiastic editor, it is clear that Sherif, the author of *Psychology of social norms*, is eminently well qualified to write this more general book in social psychology. The reader need have no fear that the author's foreign background has biased his writing. Indeed, Sherif seems thoroughly familiar with Western European ways. His Turkish background serves largely to give him an added supply of interesting illustrative materials. Here, then, is a worth-while book. It should, in the reviewer's opinion, be read by every social and clinical psychologist.

PAUL R. FARNSWORTH

Stanford University